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Managing Editor
Mahabir Singh

Editor
Anil Ahlawat

Corporate Office:
Plot 99, Sector 44 Institutional area, Gurugram -122 003 (HR).
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Regd. Office:
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CONTENTS

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CHEMISTRY MUSING

PROBLEM SET 79

Chemistry Musing was started from August '13 issue of Chemistry Today. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / NEET with additional study material.

In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / NEET. The detailed solutions of these problems will be published in next issue of Chemistry Today.

The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue. We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

JEE MAIN/NEET

1. *n*-Butane is produced by the monobromination of ethane followed by the Wurtz reaction. What would be the volume of ethane at NTP required to produce 55 g of *n*-butane, if the bromination takes place with 90 percent yield and the Wurtz reaction with 85 percent yield?

(a) 55.552 L (b) 66.662 L
(c) 42.322 L (d) 48.202 L

2. For the following sequence of reactions,

$(A) + K_2CO_3 + \text{air} \xrightarrow{\text{Heat}} (B)$

$(B) + Cl_2 \longrightarrow (C)$

which of the following is correct?

(a) (*A*) is black, MnO_2; (*B*) is blue, K_2MnO_4 and (*C*) is pink, $KMnO_4$
(b) (*A*) is green, Cr_2O_3; (*B*) is yellow, K_2CrO_4 and (*C*) is pink, $K_2Cr_2O_7$
(c) (*A*) is black, MnO_2; (*B*) is green, K_2MnO_4 and (*C*) is pink, $KMnO_4$
(d) (*A*) is black, Bi_2O_3; (*B*) is colourless, $KBiO_2$ and (*C*) is pink, $KBiO_3$

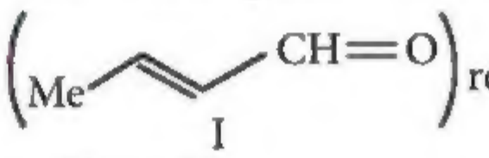
3. One mole of N_2 and 3 moles of PCl_5 are placed in a 100 litre vessel heated to 227 °C. The equilibrium pressure is 2.05 atm. Assuming ideal gas behaviour, the degree of dissociation of PCl_5 and K_p of the reaction respectively are

(a) 0.3313, 0.20 (b) 0.4152, 0.30
(c) 0.2152, 0.23 (d) 0.4925, 0.33

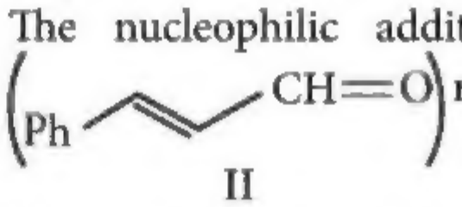
4. A metal complex having composition $Cr(NH_3)_4Cl_2Br$ has been isolated in two forms (*A*) and (*B*). The form (*A*) reacts with $AgNO_3$ to give a white precipitate readily soluble in dilute aqueous ammonia whereas (*B*) with $AgNO_3$ gives a pale yellow precipitate soluble in concentrated ammonia. The magnetic moments (spin-only value) of *A* and *B* respectively are

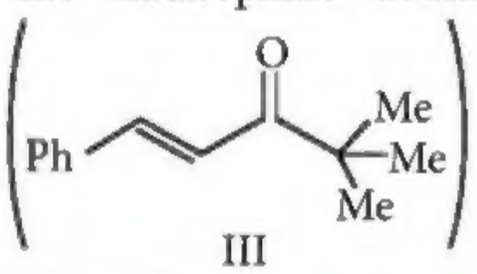
(a) 3.87 B.M. and 5.92 B.M.
(b) 1.42 B.M. and 3.87 B.M.
(c) 3.87 B.M. and 3.87 B.M.
(d) 5.92 B.M. and 3.87 B.M.

5. Which of the following statements is incorrect?

(a) The nucleophilic addition of HCN to  (I) results major addition to (C═O).

(b) The nucleophilic addition of HCN to (I) results major addition to (C═C).

(c) The nucleophilic addition of PhMgCl to  (II) results by 1,4-addition.

(d) The nucleophilic addition of PhMgCl to  (III) results in addition to (C═C).

JEE ADVANCED

6. Compound *A* (C_8H_8O) on treatment with $NH_2OH{\cdot}HCl$ gives (*B*) and (*C*). (*B*) and (*C*) rearrange to give (*D*) and (*E*), respectively, on treatment with acid. (*B*), (*C*), (*D*) and (*E*) are all isomers of molecular formula (C_8H_9NO). When (*D*) is boiled with alcoholic KOH, an oil (*F*) (C_6H_7N) separates out. (*F*) reacts rapidly with CH_3COCl to

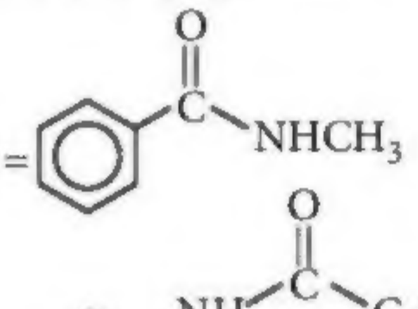
Solution Senders of Chemistry Musing
Set - 78

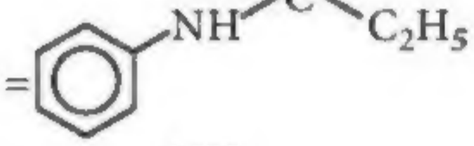
- Akash Arora, Chandigarh
- Ritika Singh, West Bengal
- Atharva Rathore, New Delhi

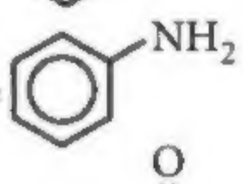
Solution Senders of Unscrambled Words

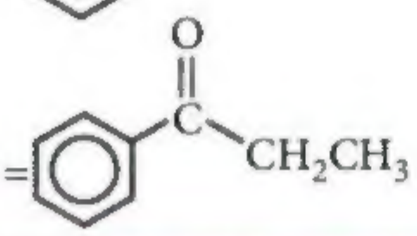
- Archisha Agrawal, Rajasthan
- Rishabh Kumar, New Delhi

give back (*D*). On the other hand, (*E*) on boiling with alkali followed by acidification gives a white solid (*G*) ($C_7H_6O_2$). Select the correct option(s).

(a) *E* = 

(b) *D* = 

(c) *F* = 

(d) *G* = 

COMPREHENSION

Chief ore of Zn is ZnS. The ore is concentrated by froth floatation process and then heated in air to convert ZnS to ZnO.

$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$ ...(i)

ZnO, thus formed is treated with dilute H_2SO_4.

$ZnO + H_2SO_4 \longrightarrow ZnSO_4 + H_2O$ ...(ii)

On electrolysis of $ZnSO_{4(aq)}$, Zn metal is produced.

$2ZnSO_4 + 2H_2O \longrightarrow 2Zn + 2H_2SO_4 + O_2$ ...(iii)

7. How many kilomoles of NaOH are required to dissolve all the ZnO produced in reaction (i) which contains 225 kg of ZnS ore?
(a) 1.16 (b) 2.32 (c) 4.64 (d) 9.28

8. What volume of 98% H_2SO_4 (by weight, density = 1.8 g/mL) is required in step (ii)?
(a) 120 L (b) 123 L (c) 1.40 L (d) 150 L

INTEGER VALUE

9. 5 mL of 8 N HNO_3, 4.8 mL of 5 N HCl and a certain volume of 17 M H_2SO_4 are mixed together and made upto 2 litres. 30 mL of this acid mixture exactly neutralises 42.9 mL of Na_2CO_3 solution containing 1 g of $Na_2CO_3 \cdot 10H_2O$ in 100 mL of water. What would be the amount of sulphate ions (in grams) present in the solution?

10. What would be the potential of an indicator electrode versus the standard hydrogen electrode, which originally contains 0.1 M MnO_4^- and 0.8 M H^+ and which was treated with Fe^{2+} necessary to reduce 90% of MnO_4^- to Mn^{2+}? $\left(E^\circ_{MnO_4^-/Mn^{2+}} = 1.51\,V\right)$

UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

Column I		Column II
1. WETPER	(a)	Soft, ductile, malleable, silvery element used in the preparation of alloy.
2. SEDMPMAYRUOI	(b)	Pentapeptides, which occur naturally in the brain and are natural analgesic.
3. GINSRITEN	(c)	Useful against viral infections, also used in treating Parkinson's disease.
4. RDISVGIER	(d)	Compounds which show dielectric hysteresis, i.e., a reversible spontaneous polarizing due to non-cancellation of the elementary dipoles in a crystal.
5. IOCTDOSECN	(e)	A process which involves the coagulation of powdered substances into a single mass by heating below the melting point of substances.
6. TDAMANAENA	(f)	Aqueous medicinal preparation obtained by boiling herbal or plant materials with water followed by filteration.
7. LEKPSIEHNAN	(g)	It consists mainly of tin with varying small amount of copper, antimony and lead.
8. CFEIREROECTSRL	(h)	It is used as a pigment, fungicide and mordant in dyeing.

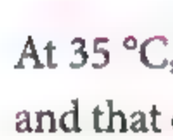
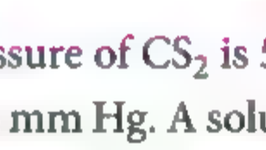
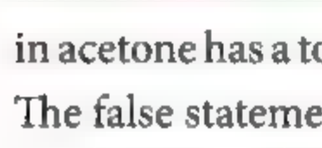
Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month.
Names of solution senders will be published in next issue.

SOLVED PAPER

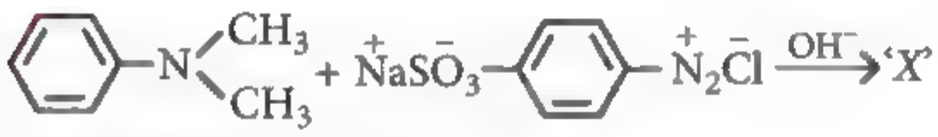
Held on
7th Jan, Morning Shift

JEE MAIN 2020

1. At 35 °C, the vapour pressure of CS_2 is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS_2 in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is
   (a) heat must be absorbed in order to produce the solution at 35°C
   (b) a mixture of 100 mL CS_2 and 100 mL acetone has a volume < 200 mL
   (c) CS_2 and acetone are less attracted to each other than to themselves
   (d) Raoult's law is not obeyed by this system.

2. 1-Methyl ethylene oxide when treated with an excess of HBr produces
   (a) 
   (b) 
   (c) 
   (d) 

3. Consider the following reaction,



   The product 'X' is used
   (a) in protein estimation as an alternative to ninhydrin
   (b) in laboratory test for phenols
   (c) as food grade colourant
   (d) in acid-base titration as an indicator.

4. A solution of *m*-chloroaniline, *m*-chlorophenol and *m*-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of $NaHCO_3$ to give fraction *A*. The left over organic phase was extracted with dilute NaOH solution to give fraction *B*. The final organic layer was labelled as fraction *C*. Fractions *A*, *B* and *C*, contain respectively
   (a) *m*-chlorobenzoic acid, *m*-chloroaniline and *m*-chlorophenol
   (b) *m*-chlorobenzoic acid, *m*-chlorophenol and *m*-chloroaniline
   (c) *m*-chlorophenol, *m*-chlorobenzoic acid and *m*-chloroaniline
   (d) *m*-chloroaniline, *m*-chlorobenzoic acid and *m*-chlorophenol.

5. The purest form of commercial iron is
   (a) wrought iron (b) pig iron
   (c) scrap iron and pig iron
   (d) cast iron.

6. Amongst the following statements that which was not proposed by Dalton, was
   (a) all the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass
   (b) matter consists of indivisible atoms
   (c) when gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same *T* and *P*
   (d) chemical reactions involve reorganization of atoms. These are neither created nor destroyed in a chemical reaction.

7. The atomic radius of Ag is closest to
   (a) Au (b) Ni (c) Hg (d) Cu.

8. The IUPAC name of the complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is
   (a) diammine(methanamine)chloridoplatinum(II) chloride
   (b) diamminechlorido(methanamine)platinum(II) chloride
   (c) diamminechlorido(aminomethane)platinum (II) chloride
   (d) *bis*ammine(methanamine)chloridoplatinum(II) chloride.

9. The theory that can completely/properly explain the nature of bonding in $[Ni(CO)_4]$ is
(a) molecular orbital theory
(b) crystal field theory
(c) Werner's theory (d) valence bond theory.

10. Match the following :

(A) Riboflavin	I. Beriberi
(B) Thiamine	II. Scurvy
(C) Pyridoxine	III. Cheilosis
(D) Ascorbic acid	IV. Convulsions

(a) (A) → I, (B) → IV, (C) → III, (D) → II
(b) (A) → III, (B) → I, (C) → IV, (D) → II
(c) (A) → III, (B) → IV, (C) → I, (D) → II
(d) (A) → IV, (B) → II, (C) → I, (D) → III

11. The dipole moments of CCl_4, $CHCl_3$ and CH_4 are in the order
(a) $CH_4 = CCl_4 < CHCl_3$
(b) $CHCl_3 < CH_4 = CCl_4$
(c) $CH_4 < CCl_4 < CHCl_3$
(d) $CCl_4 < CH_4 < CHCl_3$

12. Given that the standard potentials ($E°$) of Cu^{2+}/Cu and Cu^{+}/Cu are 0.34 V and 0.522 V respectively, the $E°$ of Cu^{2+}/Cu^{+} is
(a) −0.182 V (b) + 0.158 V
(c) −0.158 V (d) 0.182 V.

13. The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine respectively, are
(a) −333, −349, −325 and −296
(b) −349, −333, −325 and −296
(c) −296, −325, −333 and −349
(d) −333, −325, −349 and −296

14. What is the product of following reaction ?

Hex-3-ynal $\xrightarrow[\text{(ii) } PBr_3,\ \text{(iii) Mg/ether, (iv) } CO_2/H_3O^+]{\text{(i) } NaBH_4}$?

(a) 
(b) 
(c) 
(d) 

15. Consider the following reactions :

(i) $(CH_3)_3CCH(OH)CH_3 \xrightarrow{\text{conc. } H_2SO_4}$

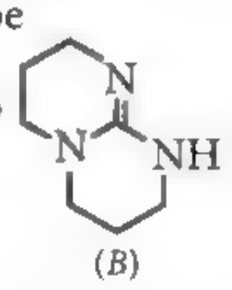
(ii) $(CH_3)_2CHCH(Br)CH_3 \xrightarrow{\text{alc. KOH}}$

(iii) $(CH_3)_2CHCH(Br)CH_3 \xrightarrow{(CH_3)_3O\ K^+}$

(iv) $(CH_3)_2\underset{\underset{OH}{|}}{C}-CH_2-CHO \xrightarrow{\Delta}$

Which of these reaction(s) will not produce Saytzeff product?
(a) (iii) only (b) (ii) and (iv)
(c) (i), (iii) and (iv) (d) (iv) only

16. The increasing order of pK_b for the following compounds will be

$\underset{(A)}{NH_2-CH=NH}$,  $\underset{(B)}{}$, $\underset{(C)}{CH_3NHCH_3}$

(a) (B) < (C) < (A) (b) (C) < (A) < (B)
(c) (A) < (B) < (C) (d) (B) < (A) < (C)

17. The number of orbitals associated with quantum numbers $n = 5$, $m_s = +\frac{1}{2}$ is
(a) 25 (b) 11 (c) 15 (d) 50

For the
SCIENTIST in


Old newspapers can be used to grow carbon nanotubes

Newspapers provide a green, economical way to produce carbon nanotubes. Newspapers can be used as a low cost, eco-friendly material on which to grow single walled carbon nanotubes on a large scale.

Carbon nanotubes are tiny molecules with incredible physical properties that can be used in a huge range of things, such as conductive films for touchscreen displays, flexible electronics, fabrics that create energy and antennas for 5G networks.

The researchers' team discovered that the large surface area of newspapers provided an unlikely but ideal way to chemically grow carbon nanotubes. Researchers said,

"Newspapers have the benefit of being used in a roll-to-roll process in a stacked form making it an ideal candidate as a low-cost stackable 2D surface to grow carbon nanotubes." However, not all newspapers are equally good, only newspapers produced with sizing made from kaolin, which is China clay, resulted in carbon nanotube growth.

"Many substances including talc, calcium carbonate, and titanium dioxide can be used in sizing in papers which act as a filler to help with their levels of absorption and wear. However, it was observed that kaolin sizing, and not calcium carbonate sizing, showed how the growth catalyst, which in case of iron, is affected by the chemical nature of the substrate."

In this research, "It has been found that a continuous flow system that dramatically reduces the cost of both substrate and post synthesis process could impact on the future mass manufacture of single walled carbon nanotubes."

18. The relative strength of interionic/intermolecular forces in decreasing order is
(a) ion-dipole > dipole-dipole > ion-ion
(b) ion-ion > ion-dipole > dipole-dipole
(c) ion-dipole > ion-ion > dipole-dipole
(d) dipole-dipole > ion-dipole > ion-ion.

19. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resins method is
(a) less efficient as the resins cannot be regenerated
(b) less efficient as it exchanges only anions
(c) more efficient as it can exchange only cations
(d) more efficient as it can exchange both cations as well as anions.

20. Oxidation number of potassium in K_2O, K_2O_2 and KO_2, respectively, is
(a) +1, +1 and +1 (b) +2, +1 and $+\frac{1}{2}$
(c) +1, +2 and +4 (d) +1, +4 and +2.

21. Two solutions *A* and *B*, each of 100 L was made by dissolving 4 g of NaOH and 9.8 g of H_2SO_4 in water, respectively. The pH of the resultant solution obtained from mixing 40 L of solution *A* and 10 L of solution *B* is _____.

22. The number of chiral carbons in chloramphenicol is _____.

23. For the reaction ; $A_{(l)} \longrightarrow 2B_{(g)}$
$\Delta U = 2.1$ kcal, $\Delta S = 20$ cal K^{-1} at 300 K.
Hence, ΔG in kcal is _____.

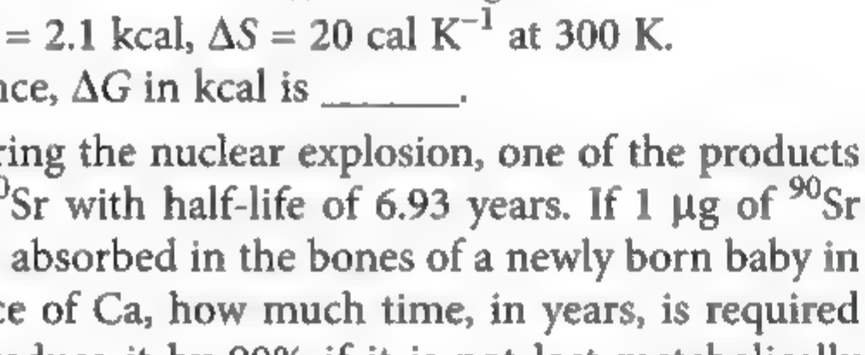
24. During the nuclear explosion, one of the products is ^{90}Sr with half-life of 6.93 years. If 1 μg of ^{90}Sr was absorbed in the bones of a newly born baby in place of Ca, how much time, in years, is required to reduce it by 90% if it is not lost metabolically _____.

25. Chlorine reacts with hot and concentrated NaOH and produces compounds (*X*) and (*Y*). Compound (*X*) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (*Y*) is _____.

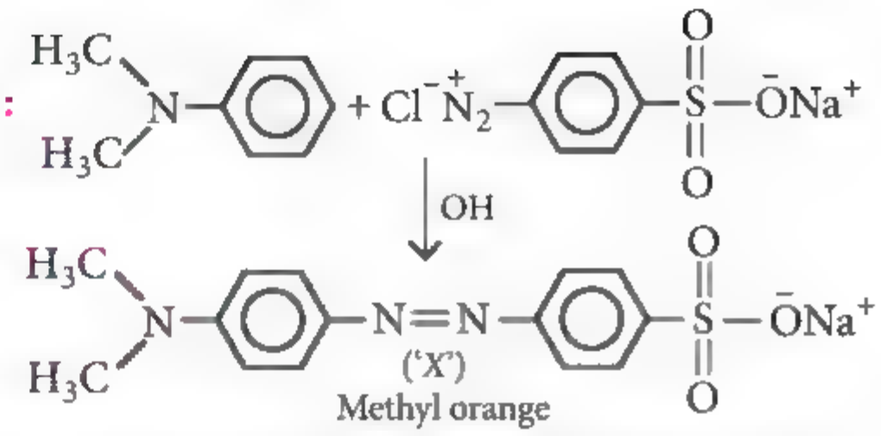
SOLUTIONS

1. (b) : Mixture of pure CS_2 and CH_3COCH_3 shows positive deviation from Raoult's law. For such solution, $\Delta V_{mixing} > 0$ and $\Delta H_{mixing} > 0$.

2. (c) :

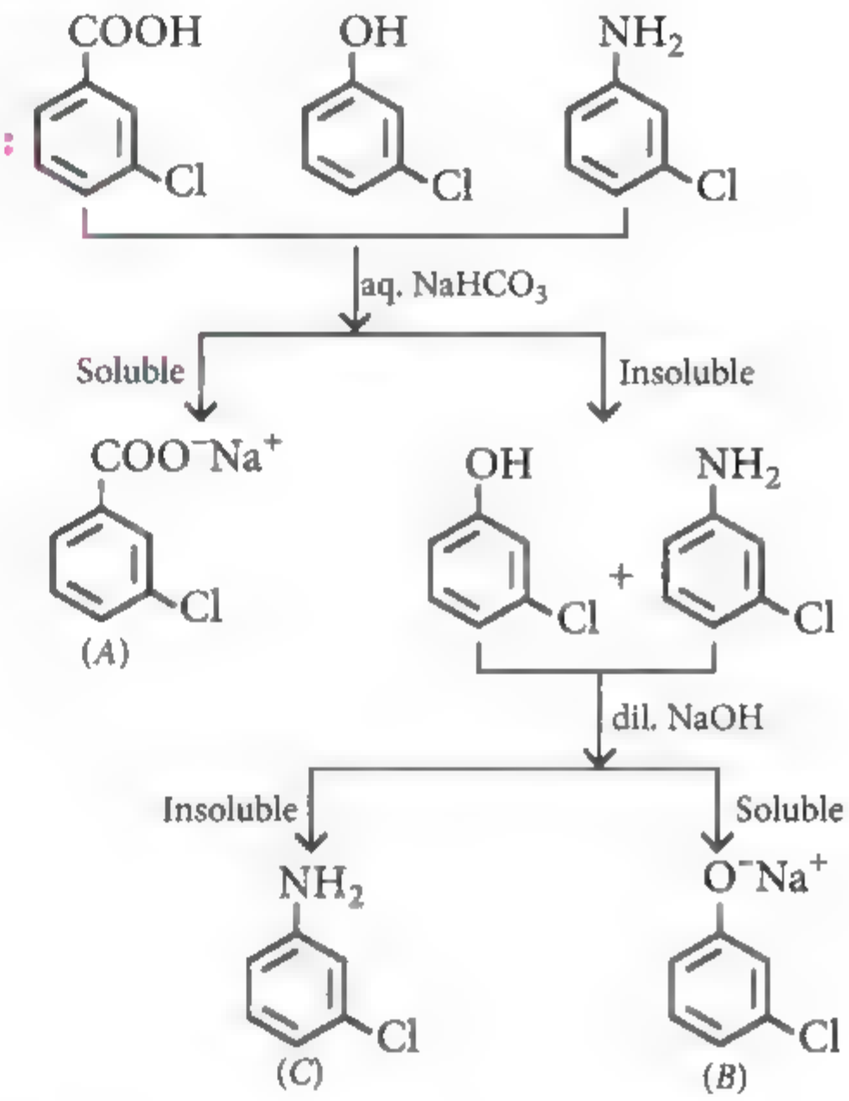


3. (d) :



Methyl orange is widely used as an indicator in acid-base titration.

4. (b) :



5. (a)

6. (c) : Statement (c) is Gay Lussac's law of gaseous volumes.

7. (a) : Atomic radius of Ag (144 pm) and Au (144 pm) are same.

8. (b)

9. (a) : Molecular orbital theory properly explains the nature of bonding in $[Ni(CO)_4]$.

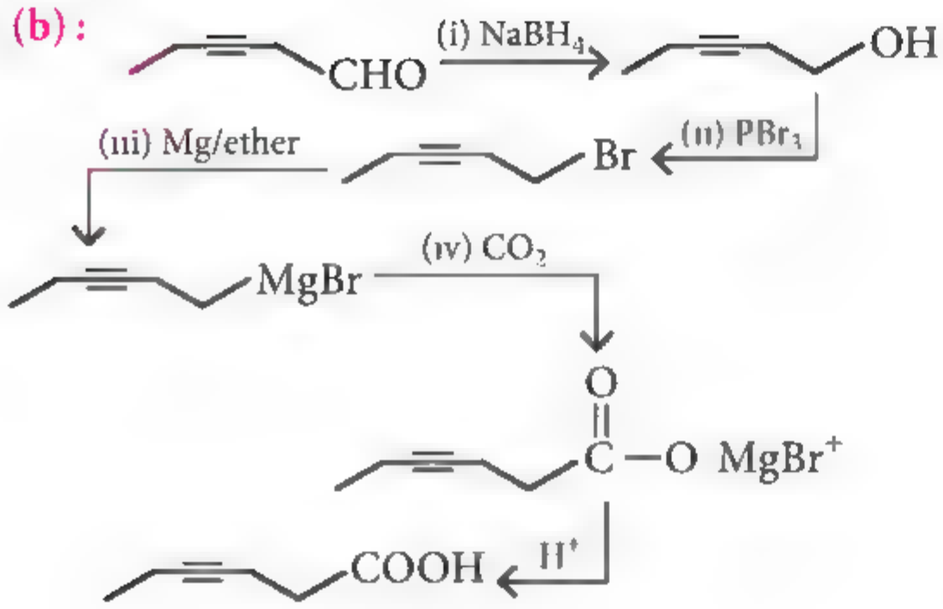
10. (b)

11. (a) : Dipole moment (μ) is zero for symmetrical molecules *i.e.*, $\mu_{CCl_4} = \mu_{CH_4} = 0$ but $\mu_{CHCl_3} > 0$.

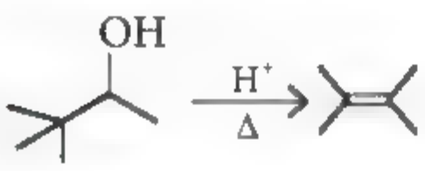
12. (b) : $Cu^{2+} + e^- \longrightarrow Cu^+$; $\Delta G_1 = -nFE_1^\circ$
$= -1 \times F \times E_1^\circ$
$Cu^+ + e^- \longrightarrow Cu$; $\Delta G_2 = -1 \times F \times 0.522$
$Cu^{2+} + 2e^- \longrightarrow Cu$; $\Delta G_3 = -2 \times F \times 0.34$
Now, $\Delta G_3 = \Delta G_1 + \Delta G_2$
$-2 \times F \times 0.34 = -FE_1^\circ - 0.522F$
$E_1^\circ = +0.158$ V

13. (a)

14. (b) :

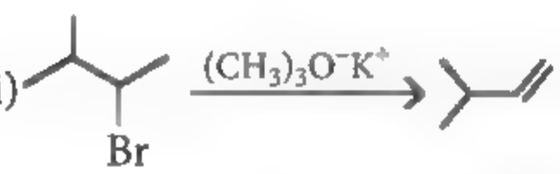


15. (a) : (i)

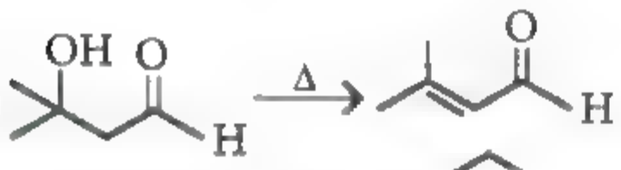


(ii)

(iii)

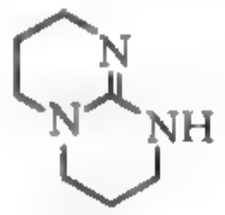


(iv)



16. (d) : $NH_2-CH=NH$, CH_3NHCH_3

(A) (Amidine type)



(B) (Guanidine type)

(C) (2° Amine)

Amidines and guanidines are very strong bases, 100-1000 times stronger than tertiary amines due to very favourable resonance structures of their protonated forms. The conjugate acid of guanidine is most resonance stabilised followed by amidine.

$\therefore$ Order of basicity : $B > A > C$

Order of pK_b : $C > A > B$

17. (a) : Total no. of electrons in $n = 5$ are $2n^2$ *i.e.*, $2 \times 5^2 = 50$

Thus, electrons having, $m_s = +\frac{1}{2} = \frac{50}{2} = 25$ which is equal to no. of orbitals.

18. (b) **19. (d)**

20. (a) : For K_2O : $2x - 2 = 0 \Rightarrow x = +1$

For K_2O_2 : $2x - 2 = 0 \Rightarrow x = +1$

(In peroxide, the O.S. of Oxygen is –1.)

For KO_2 : $x - 2 \times \frac{1}{2} = 0 \Rightarrow x = +1$

(In superoxide, the O.S. of oxygen is $-\frac{1}{2}$.)

21. (10.60) : $M_{H_2SO_4} = \frac{9.8}{98 \times 100} = 10^{-3}$

$M_{NaOH} = \frac{4}{40 \times 100} = 10^{-3}$

$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$

Concentration of resultant solution after neutralisation

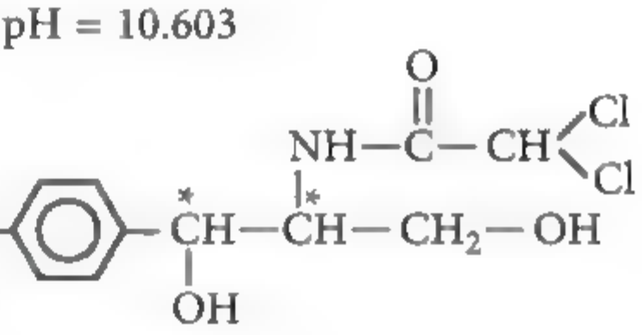
$= \frac{40 \times 10^{-3} - 10 \times 10^{-3} \times 2}{50} = \frac{20}{50} \times 10^{-3}$

As NaOH is in excess therefore, resultant solution will be alkaline.

$\therefore \quad [OH^-] = \frac{2}{5} \times 10^{-3}$

pOH = 3.397 ; pH = 10.603

22. (2) :



23. (–2.7) : We know that,

$\Delta H = \Delta U + \Delta n_g RT$

$= 2.1 \times 10^3 + 2(2)(300) = 2100 + 1200 = 3300$ cal

$\Delta G = \Delta H - T\Delta S$

$= 3300 - (300)(20) = 3300 - 6000$

$= -2700$ cal $= -2.7$ kcal

24. (23.03) : $t_{90\%} = \frac{1}{k} \ln \frac{a}{(a-x)} = \frac{1}{k} \ln \frac{100}{10} = \frac{\ln 10}{k}$

$t_{50\%} = \frac{1}{k} \ln \frac{a}{(a-x)} = \frac{1}{k} \ln \frac{100}{50} = \frac{\ln 2}{k}$

$\frac{t_{90\%}}{t_{50\%}} = \frac{\ln 10/k}{\ln 2/k}$

$t_{90\%} = \frac{6.93 \times \ln 10}{0.693} = 23.03$ years

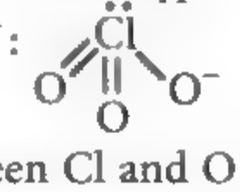
25. (1.67) : $3Cl_2 + 6NaOH \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

(Hot and conc.) (X) (Y) Sodium chlorate

$NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(X) White ppt.

Structure of ClO_3^- :



Bond order between Cl and O in ClO_3^-

$= \frac{\text{Total bonds}}{\text{Total sigma bonds}} = \frac{5}{3} = 1.67$

Rank Enhancer

This column is specially designed to make your concepts crystal clear.

Colligative properties

Properties of solution which depends on number of particles but not on the nature of solute are known as colligative properties.

Types of Colligative Properties

- (I) Relative lowering of vapour pressure $\left(\frac{p^\circ_{solvent} - p_{solution}}{p^\circ_{solvent}}\right)$
- (II) Elevation in boiling point (ΔT_b)
- (III) Depression in freezing point (ΔT_f)
- (IV) Osmotic pressure (π)

Note : Colligative properties are properties of only dilute solutions as they only behave as ideal solutions.

I. Relative Lowering of Vapour Pressure

When a non-volatile solute is added to a volatile solvent, its vapour pressure decreases. Such decrease with respect to vapour pressure of solvent is called relative lowering of vapour pressure.

$$\frac{p^\circ_{solvent} - p_{solution}}{p^\circ_{solvent}} = X_{solute}$$

According to Raoult's law for ideal solutions

$p_{solution} = p^\circ_A X_A + p^\circ_B X_B$

[B = Solute (non-volatile), A = Solvent (volatile)]

$p^\circ_B = 0$ as solute is non-volatile

and $X_A + X_B = 1 \Rightarrow X_A = 1 - X_B$

$P_{solution} = P^\circ_A(1 - X_B) + 0 \times X_B$

$p_{solution} = p^\circ_A - p^\circ_A \times X_B$

$p^\circ_A X_B = p^\circ_A - p_{solution}$

$$X_B = \frac{p^\circ_A - p_{solution}}{p^\circ_A}$$

or $$\frac{p^\circ_{solvent} - p_{solution}}{p^\circ_{solvent}} = X_{solute}$$

$$\frac{p^\circ_{solvent} - p_{solution}}{p^\circ_{solvent}} = \frac{n_{solute}}{n_{solute} + n_{solvent}}$$

For dilute solution, $n_{solute} <<< n_{solvent}$

$$\therefore \quad \frac{p^\circ_{solvent} - p_{solution}}{p^\circ_{solvent}} = \frac{n_{solute}}{n_{solvent}}$$

$$\frac{p^\circ_{solvent} - p_{solution}}{p^\circ_{solvent}} = \frac{w_{solute} \times M_{solvent}}{w_{solvent} \times M_{solute}}$$

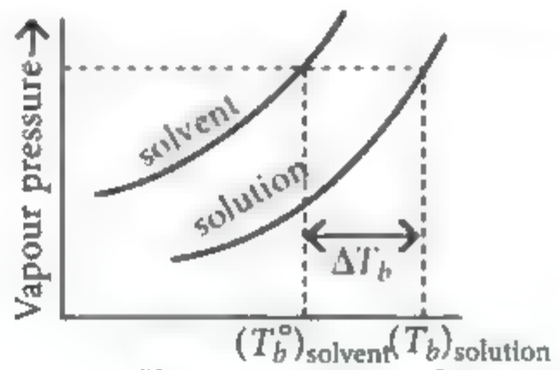
II. Elevation in Boiling Point

When a non-volatile solute is added to volatile solvent, resulting solution will have less vapour pressure. Hence, boiling point will increase. Such increase in boiling point is called elevation in boiling point. It is represented by ΔT_b.

$$\Delta T_b = (T_b)_{solution} - (T^\circ_b)_{solvent}$$

$$= K_b \times m = K_b \times \frac{(\text{wt.} / \text{m.wt.})_{solute}}{(\text{wt. of solvent in g})} \times 1000$$

where, K_b = Ebullioscopic constant or molal elevation constant.



Expression for molal elevation constant from enthalpy of vaporisation :

$$K_b = \frac{RT^{\circ 2}_b}{1000 \times L_v}$$

R = Universal gas constant

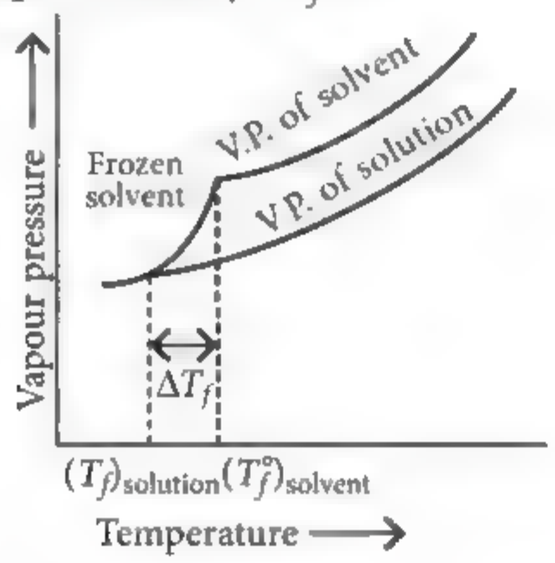
T°_b = Boiling point of solvent

L_v = Latent heat of vaporisation

By K. Vijay Bhasker, Senior faculty at Sri Chaitanya Educational Institution, Visakhapatnam

III. Depression in Freezing Point

Since vapour pressure of solution is lower than solvent, solid form separates out at a lower temperature. Such decrease in freezing point is called depression in freezing point. It is represented by ΔT_f.



$$\Delta T_f = (T_f^\circ)_{solvent} - (T_f)_{solution} = K_f \times m$$

$$= K_f \times \frac{(\text{wt./ mol. wt.})_{solute}}{(\text{wt. of solvent in g})} \times 1000$$

where, K_f = Cryoscopic constant or molal depression constant.

Expression for molal depression constant from enthalpy of fusion

$$K_f = \frac{RT_f^{\circ 2}}{1000 \times L_f}$$

where, R is universal gas constant. T_f° is freezing point of the solvent, L_f is latent heat of fusion.

IV. Osmotic Pressure

The process of flow of solvent from low concentrated solution/solvent to more concentrated solution through a semipermeable membrane is called osmosis.
The external pressure required to stop osmosis is called osmotic pressure.

Isotonic, Hypertonic and Hypotonic solutions

- If two solutions have same osmotic pressures then they are called isotonic solutions.
- If two solutions have different osmotic pressures, then the solution with higher osmotic pressure is called hypertonic and solution with lower osmotic pressure is called hypotonic solution.

Exo-osmosis and Endo-osmosis

The outward flow of solvent from cell is called exo-osmosis and the net inward flow of solvent into the cell is called endo-osmosis.
e.g., Grapes in water ⟹ Endo-osmosis
Grapes in sugar solution ⟹ Exo-osmosis
Osmotic pressure (π) = $C \times S \times T$
C = Concentration of solution
S = Universal solution constant
T = Temperature in Kelvin

Colligative Properties for Abnormal Solutions

Certain solutes show abnormal molecular masses either due to dissociation or association. Such solutions are called abnormal solutions. They are identified by van't Hoff factor(i).

$$i = \frac{\text{Normal molecular mass}}{\text{Observed molecular mass}}$$

$$= \frac{\text{Observed colligative property}}{\text{Normal colligative property}}$$

$$= \frac{\text{Number of moles after dissociation/association}}{\text{Number of moles dissolved}}$$

If $i = 1$, solution is not abnormal *i.e.*, solute neither dissociates nor associates, *e.g.*, sucrose, glucose and urea.
If $i > 1$, solution is abnormal due to dissociation of solute, *e.g.*, NaCl, $CaCl_2$, $K_4[Fe(CN)_6]$, etc.
If $i < 1$, solution is abnormal due to association of solute, *e.g.*, benzoic acid in benzene.

van't Hoff factor for solute dissociating :

$$A_xB_y \Rightarrow xA^{y+} + yB^{x-}$$

Initial moles	1	0	0
After dissociation	$1-\alpha$	$x\alpha$	$y\alpha$

$$i = \frac{1-\alpha+x\alpha+y\alpha}{1+0+0} = 1+(x+y-1)\alpha$$

van't Hoff factor for solute associating :

$$nA \rightarrow A_n$$

Intial moles	1	0
After association	$1-\alpha$	α/n

$$i = \frac{1-\alpha+\alpha/n}{1+0} = 1-\left(1-\frac{1}{n}\right)\alpha$$

Modified Colligative Properties for Abnormal Solutions

(1) Relative lowering of vapour pressure

$$= \frac{p_A^\circ - p_A}{p_A^\circ} = iX_B$$

(2) Elevation in boiling point (ΔT_b) = $i \times K_b \times m$
(3) Depression in freezing point (ΔT_f) = $i \times K_f \times m$
(4) Osmotic pressure (π) = $iCST$

Some facts to be remembered

(I) Methods for measuring colligative properties :

- Relative lowering of V.P.–Ostwald and Walker method
- Elevation in B.Pt.–Landsberger method
- Depression in F.Pt.–Beckmann method
- Osmotic pressure-Berkely and Hartely method

(II) Osmotic pressure is the best method for determining molecular mass of polymer as in other colligative properties, observed values are too small and accuracy lost.

(III) Ethylene glycol ($CH_2OH — CH_2OH$) is added to water before using in radiators because it is being non-volatile. It reduces freezing point thus avoid ice formation in winter. Hence called "antifreeze" and also increases boiling point thus avoids topping of radiator water in summer.

(IV) 0.9% solution of NaCl is isotonic with human RBC.

(V) Plasmolysis : Shrinking of plant cells when placed in hypertonic solutions.

PROBLEMS

1. If the observed and theoretical molecular mass of *AB* electrolyte is 31.80 and 58.50 respectively, then the degree of dissociation of *AB* is
   (a) 83.96% (b) 90% (c) 8.39% (d) 100%

2. If all symbols have their usual meaning, then for non-volatile and non-electrolyte solute, the value of $\lim_{m\to 0}\left[\frac{\Delta T_b}{m}\right]$ is
   (a) infinity (b) zero
   (c) ΔT_b (d) K_b.

3. If two elements *P* and *Q* form compounds of molecular formulae PQ_2 and PQ_4. When 1 g of PQ_2 dissolved in 20 g of C_6H_6 then decrease in freezing point by 2.3 K. But when 1 g of PQ_4 dissolved in 20 g of C_6H_6, it decreases the freezing point by 1.3 K. Atomic masses of *P* and *Q* are (K_f of benzene is 5.1 K m^{-1}).
   (a) 25.58 and 42.64 (b) 22.64 and 55.58
   (c) 42.64 and 25.58 (d) 45.64 and 22.58.

4. If K_b/K_f of electrolyte *AB* is 0.3 and its aq. solution is 100% ionised and have boiling point 101.08 °C. If the freezing point of same solution is –1.80 °C then *AB* is
   (a) 100% ionised at freezing point also
   (b) no ionisation at freezing point
   (c) 50% ionised at freezing point
   (d) dimerisation takes place at freezing point.

5. If pK_a of monobasic acid *HA* is 4 then its van't Hoff factor of 0.01 M solution is
   (a) 1.10 (b) 1.01 (c) 1.20 (d) 1.02

6. If osmotic pressure of solution of insulin at 298 K is found to be 7.2×10^{-3} atm then height of water column due to this osmotic pressure is (Density of Hg = 13.6 g/cm^3)
   (a) 760 mm (b) 70.28 mm
   (c) 74.42 mm (d) 0.76 mm.

7. 1 m aq. urea solution freezes at –1.86 °C and 0.01 M aq. acetic acid solution freezes at –0.02046 °C. The pH of acetic acid is (assuming $m = M$)
(a) 3 (b) 3.2 (c) 4.2 (d) 2

8. van't Hoff factor of very dilute phosphorous acid is
(a) 7 (b) 8 (c) 4 (d) 3

9. Which of the following is not a colligative property?
(a) Boiling point elevation
(b) Lowering of vapour pressure
(c) Osmotic pressure
(d) Decrease in freezing point

10. Which of the following have lowest freezing point?
(a) 0.2 m NaCl (b) 0.2 m glucose
(c) 0.2 m sucrose (d) 0.2 m $BaCl_2$

SOLUTIONS

1. (a) : van't Hoff factor $(i) = \dfrac{MM_{\text{theoretical}}}{MM_{\text{experimental}}}$

$$= \frac{58.50}{31.80} = 1.8396$$

$$\begin{array}{ccccc} AB & \rightleftharpoons & A^+ & + & B^- \\ 1 & & 0 & & 0 \\ 1-\alpha & & \alpha & & \alpha \end{array}$$

$$i = \frac{1+\alpha}{1} = 1.8396 \Rightarrow \alpha = 0.8396 \text{ or } 83.96\%$$

2. (d) : Given, $\lim\limits_{m\to 0}\left[\dfrac{\Delta T_b}{m}\right]$

According to elevation in boiling point,

$\Delta T_b = i \times K_b \times m$

But $\dfrac{\Delta T_b}{m} = K_b$ ($i = 1$, For non-electrolyte)

$$\therefore \lim_{m\to 0}\left[\frac{\Delta T_b}{m}\right] = \lim_{m\to 0}(K_b) = K_b$$

3. (a) : $(\Delta T_f)_{PQ_2} = K_f \times m$

$$\Rightarrow 2.3 = 5.1 \times \frac{\left(\dfrac{1}{P+2Q}\right)}{20} \times 1000$$

$$P + 2Q = \frac{51\times 50}{23} \quad \ldots (1)$$

$$(\Delta T_f)_{PQ_4} = K_f \times m \Rightarrow 1.3 = 5.1 \times \frac{\left(\dfrac{1}{P+4Q}\right)}{20} \times 1000$$

$$P + 4Q = \frac{51\times 50}{13} \quad \ldots (2)$$

From eq. (1) and (2), $P = 25.58$ and $Q = 42.64$

4. (c) : $\dfrac{\Delta T_b}{\Delta T_f} = \dfrac{i\times K_b \times m}{i \times K_f \times m}$

Given; $\Delta T_b = 101.08 - 100 = 1.08$

$\Delta T_f = 0 - (-1.80) = 1.80$ and $K_b/K_f = 0.3$

$$\frac{1.08}{1.80} = \frac{i_{\text{B.Pt.}}}{i_{\text{F.Pt.}}} \times 0.3 \times 1$$

As AB is 100% ionised therefore its $i_{\text{B Pt}} = 2$

$$i_{\text{F.Pt.}} = \frac{2\times 0.3\times 1.8}{1.08} = 1$$

$\therefore$ 50% ionised at freezing point.

5. (a) :

$$\begin{array}{ccccc} HA & \rightleftharpoons & H^+ & + & A^- \\ 1 & & 0 & & 0 \\ C(1-\alpha) & & C\alpha & & C\alpha \end{array}$$

$K_a = C\alpha^2$

$10^{-4} = 10^{-2} \times \alpha^2 \Rightarrow \alpha = 0.1$

For HA, $i = 1 + \alpha = 1 + 0.1 = 1.1$

6. (c) : $\rho = h \times d \times g$

For 1 atm = 760 mm of Hg

Given, $7.2 \times 10^{-3} \equiv 7.2 \times 10^{-3} \times 760$ mm of Hg

$\rho_{H_2O} = \rho_{Hg}$

$(hdg)_{H_2O} = (hdg)_{Hg}$

$h \times 1 \times 9.8 = (7.2 \times 10^{-3} \times 760) \times 13.6 \times 9.8$

$h = 74.42$ mm of Hg

7. (a) : $\dfrac{(\Delta T_f)_{\text{urea}}}{(\Delta T_f)_{\text{acetic acid}}} = \dfrac{(i\times K_f \times m)_{\text{urea}}}{(i\times K_f \times m)_{\text{acetic acid}}}$

$$\frac{1.86}{0.02046} = \frac{1\times K_{f_{\text{urea}}} \times 1}{i \times K_{f_{\text{acetic acid}}} \times 10^{-2}}$$

$$i = \frac{0.02046}{1.86\times 10^{-2}} = 1.1$$

$$\begin{array}{ccccc} CH_3COOH & \rightleftharpoons & CH_3COO^- & + & H^+ \\ 1 & & 0 & & 0 \\ (1-\alpha) & & \alpha & & \alpha \end{array}$$

$i = 1 + \alpha = 1.1 \Rightarrow \alpha = 0.1$

$\therefore$ $[H^+] = C\alpha = 10^{-2} \times 10^{-1} = 10^{-3}$

$pH = -\log 10^{-3} = 3$

8. (d) :

$$\begin{array}{ccccc} H_3PO_3 & \rightleftharpoons & 2H^+ & + & HPO_3^- \\ 1 & & 0 & & 0 \\ 1-1 & & 2 & & 1 \end{array}$$

$$i = \frac{3}{1} = 3$$

9. (b) : Relative lowering of vapour pressure is a colligative property but not lowering of vapour pressure.

10. (d) : $BaCl_2$ have highest i (*i.e.*, 3)

$\therefore$ Freezing point is lowest.

$\left\{\text{freezing point } \propto \dfrac{1}{i} \text{ if '}m\text{' is same.}\right\}$

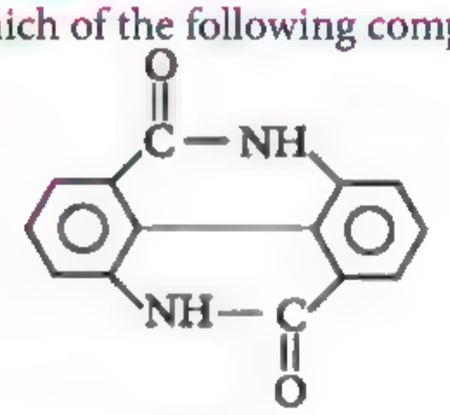
CONCEPT BOOSTER

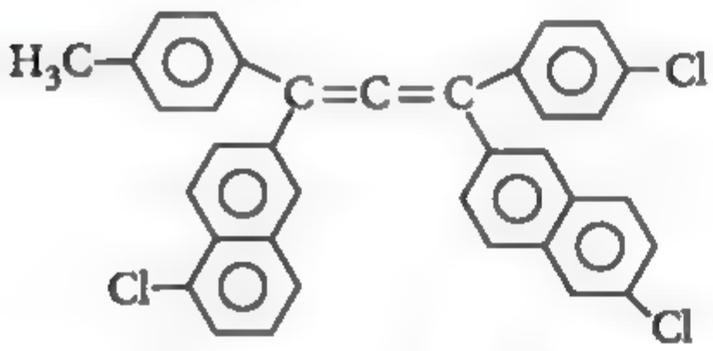
Hello Students!! Hope your first JEE Main has gone well and those for whom exam has not gone well, they have at least identified their flaws and have already started working on that. Now the forthcoming exams are your main points of attention. So start working with full strategy. As your friend I am always their beside you and in this article I have presented 15 questions which are important as well as concept based. Ideal time to solve this paper is 25 minutes. Hope you will like it.

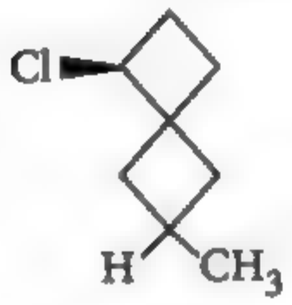
*Arunava Sarkar

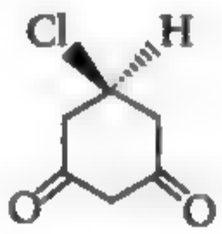
SINGLE CORRECT OPTION

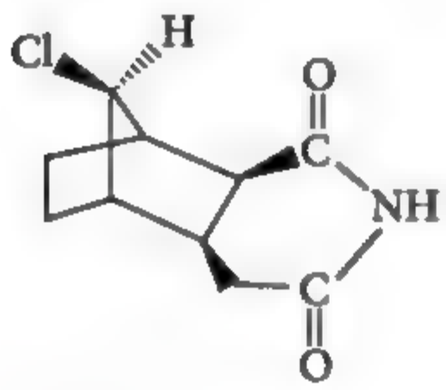
1. Which of the following compounds are chiral?

(i) 

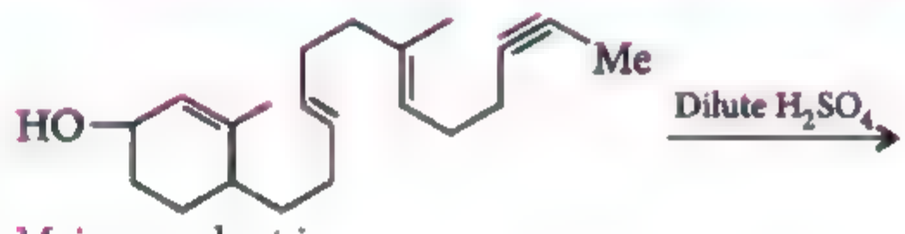
(ii) 

(iii) 

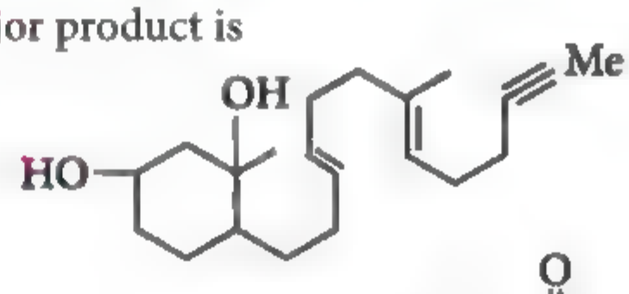
(iv) 

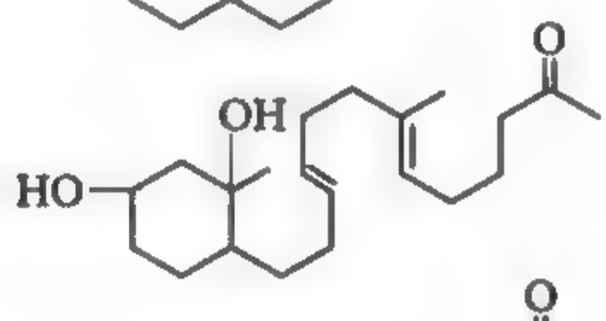
(v) 

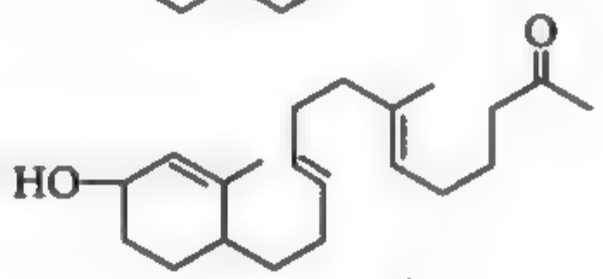
(a) i, ii, iii, iv
(b) ii, iii, iv, v
(c) i, iv, v
(d) None of these

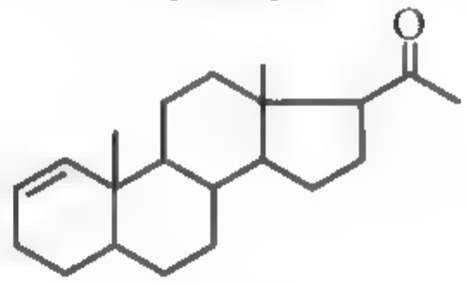
2. 

Major product is

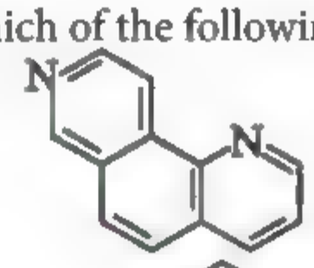
(a) 

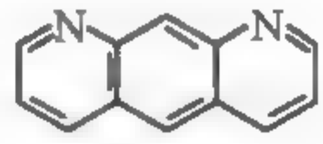
(b) 

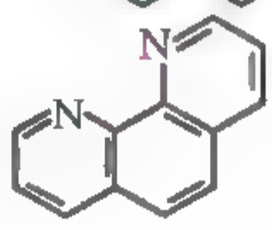
(c) 

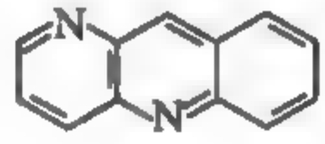
(d) 

3. Which of the following is not basic?

(a) 

(b) 

(c) 

(d) 

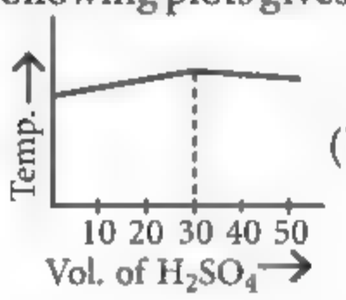
4. The increasing order of atomic radii of the following group 13 elements is
(a) Al< Ga < In < Tl (b) Ga < Al < In < Tl
(c) Al< In < Ga < Tl (d) Al < Ga < Tl < In

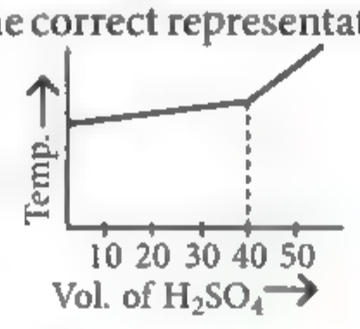
5. Which is the correct order of melting point?
(a) $NH_3 > PH_3 > (CH_3)_3N$
(b) $(CH_3)_3N > NH_3 > PH_3$
(c) $NH_3 > (CH_3)_3N > PH_3$
(d) $PH_3 > (CH_3)_3N > NH_3$

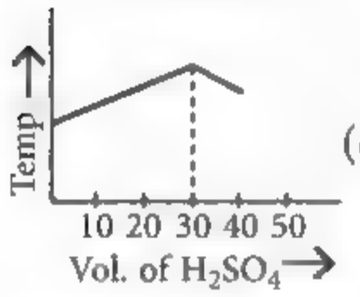
6. What is the atmospheric pressure (in atm) at 15 °C on a mountain that stands 2500 m above the sea level, given that the pressure on the ground level is 1 atm and that other conditions are negligible?
(a) 0.42 (b) 1.92 (c) 0.48 (d) None

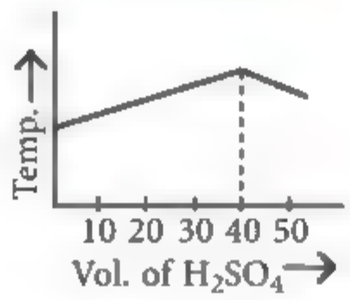
7. Which of the following statements is correct?
(a) $\left(\frac{\partial H}{\partial T}\right)_P - \left(\frac{\partial U}{\partial T}\right)_V = R$
(b) $\left(\frac{\partial H}{\partial T}\right)_P > \left(\frac{\partial U}{\partial T}\right)_V$
(c) $\left(\frac{\partial U}{\partial V}\right)_T$ for ideal gas is zero.
(d) All of the above

8. In an experiment to determine the enthalpy of neutralisation of sodium hydroxide with sulphuric acid, 40 cm^3 of 0.6 M NaOH were titrated thermometrically with 0.30 M H_2SO_4. Which of the following plots gives the correct representation?

(a)


(b)


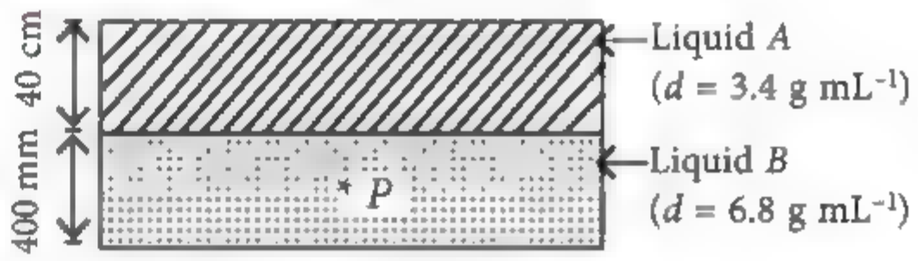
(c)


(d)


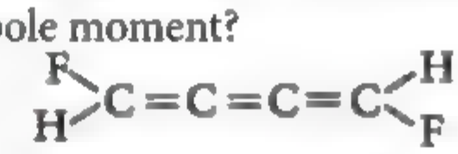
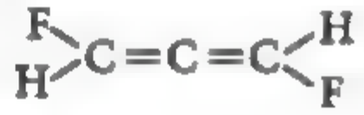
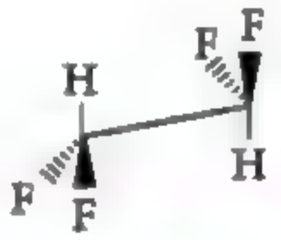
9. For given two equilibriums attained in a container which is correct if degree of dissociation of A and A' are α and α' respectively (p' = partial pressure at equilibrium)?
$A_{(s)} \rightleftharpoons 2B_{(g)} + C_{(g)}$; $K_{p_1} = 8 \times 10^{-2}$
$A'_{(s)} \rightleftharpoons 2B_{(g)} + D_{(g)}$; $K_{p_2} = 2 \times 10^{-2}$
(a) $\frac{K_{p_2}}{K_{p_1}} = \left(\frac{3\alpha' + 2\alpha}{3\alpha + 2\alpha'}\right) \cdot \frac{\alpha}{\alpha'}$
(b) $\frac{p'_C}{p'_D} = 4$
(c) $p'_B = p'_C + p'_D$
(d) $\alpha < \alpha'$

10. 500 mL of 0.2 M Na_2SO_4 solution is mixed with 100 mL of 17.1% (w/v) $Al_2(SO_4)_3$ solution and resulting solution is diluted to 5 times. Find the molarity of SO_4^{2-} ions in the final solution. (Atomic masses : Al = 27, S = 32, Na = 23)
(a) $M/15$ (b) $5M/12$
(c) $12M/5$ (d) None of these

11. Find pressure (in atm) at point P, 10 cm above the bottom of container.

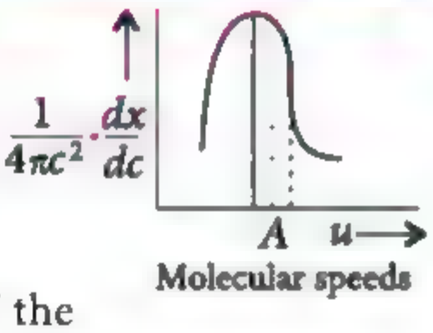


(a) 91/76 (b) 156/76
(c) 101/76 (d) None of these

12. Which of the following molecules doesn't have dipole moment?
(a) 
(b) 
(c) 
(d) 

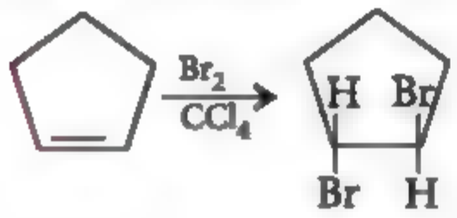
MORE THAN ONE CORRECT OPTIONS

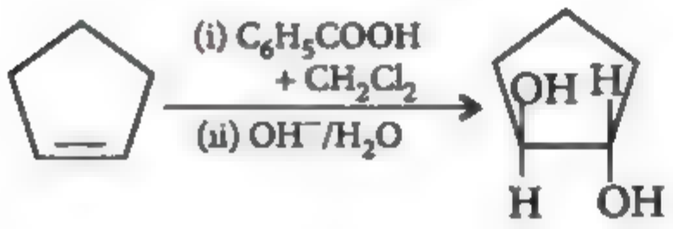
13. The Maxwell-Boltzmann distribution law of molecular speeds is graphically represented as :

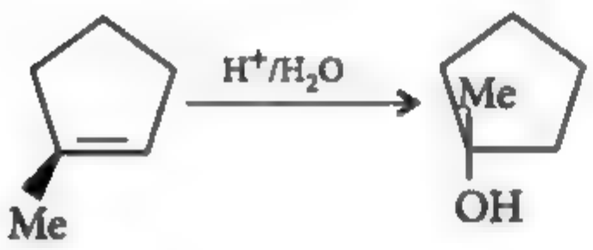


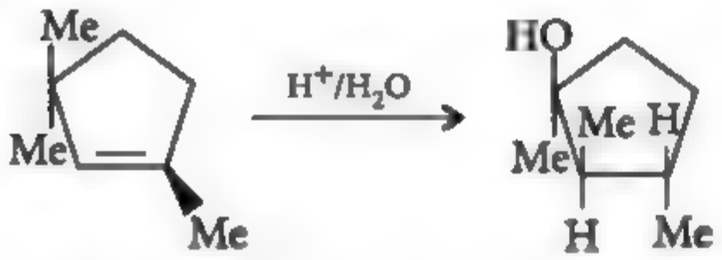
This curve has which of the following characteristics?
(a) It has symmetrical distribution.
(b) The point A on x-axis represents the most probable speed.
(c) The area under the curve gives the total number of molecules.
(d) The maximum shifts to the right as temperature increases.

14. Which of the following reactions are correct?

(a) 

(b) 

(c) 

(d) 

15. Which of the following represent correct order?

(a) Polarity of M – H bond :
$PH_3 < AsH_3 < SbH_3 < NH_3$

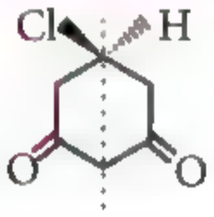
(b) Bond angles : $NH_3 > AsH_3 > SbH_3 > BiH_3$

(c) Bond angles : $NO_2^+ > NO_2 > NO_2^-$

(d) Stability : $H_2 > H_2^+ = H_2^-$

SOLUTIONS

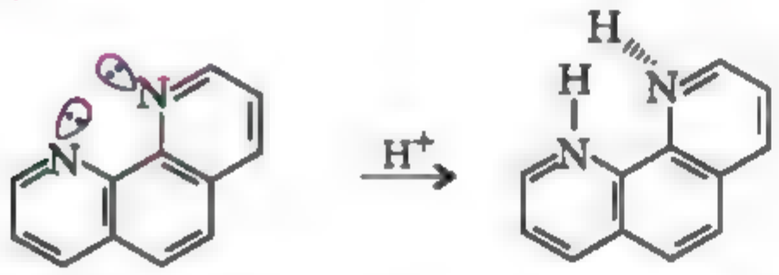
1. **(d) :** (i) has centre of symmetry.

(iv) 

Plane of symmetry

2. **(d) :** First attack on the –OH group.

3. **(c) :**



Here, two lone pairs are close enough and hence creat more repulsion and therefore, highly willing to get protonated It is a kind of field effect.

After protonation attractive force comes into play (H-bonding).

4. **(b) :** $r_{Ga} < r_{Al}$
(135 pm) (143 pm)

It is because of poor shielding of nuclear charge by 3d electrons. In and Tl follow regular trend.

5. **(c) :** $NH_3 = -77.7\ °C$, $(CH_3)_3N = -117\ °C$, $PH_3 = -133\ °C$
NH_3 has H-bonding. $(CH_3)_3N$ has higher molar mass than PH_3.

6. **(d) :** $2.203 \log\left(\frac{P_h}{P_o}\right) = -\frac{mgh}{RT}$

7. **(d) :** $\left(\frac{\partial H}{\partial T}\right)_P = C_P$, $\left(\frac{\partial U}{\partial T}\right)_V = C_V$

Again, $\left(\frac{\partial U}{\partial V}\right)_T = 0$ for ideal gas.

8. **(d) :** Meq. of NaOH = $(40 \times 0.6) = 24$
$\therefore$ Meq. of H_2SO_4 needed = 24
If vol. of H_2SO_4 needed = V mL
$V \times 0.3 \times 2 = 24 \Rightarrow V = 40$ mL
$\therefore$ (d) is correct, as temperature increases during neutralisation and then decreases due to increase in volume of solution.

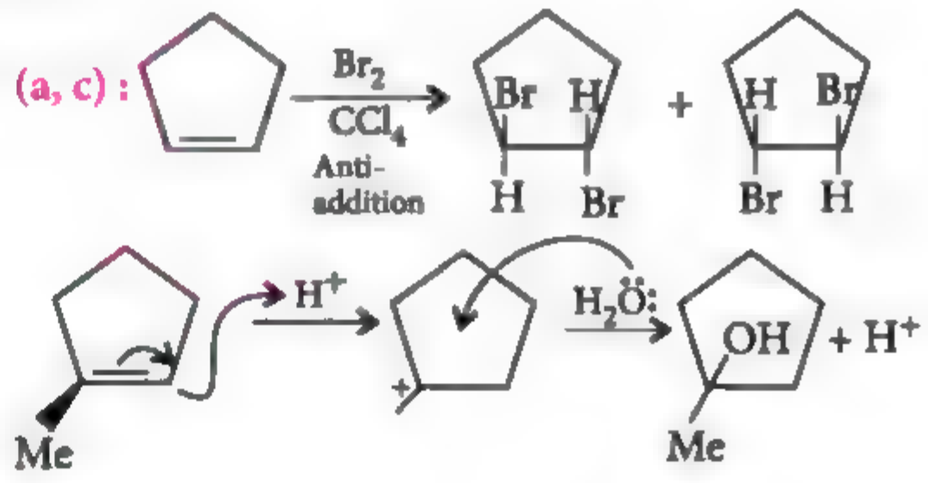
9. **(b) :** $A_{(s)} \rightleftharpoons 2B_{(g)} + C_{(g)}$;
$(2p_1 + 2p_2) \quad p_1$
$\therefore \quad K_{p_1} = 2^2 (p_1 + p_2)^2 \cdot p_1$
$A'_{(s)} \rightleftharpoons 2B_{(g)} + D_{(g)}$
$(2p_2 + 2p_1) \quad p_2$
$K_{p2} = 2^2 (p_1 + p_2)^2 \cdot p_2$
$K_{p1}/K_{p2} = p_1/p_2 = 4$

10. **(d) :** $[(500 \times 0.2)/1000 + (17.1 \times 3)/342]/0.6 \times 5 = M/12$

11. **(c) :** $p_{gas} = 76 + \frac{40 \times 3.4}{13.6} + \frac{30 \times 6.8}{13.6}$
= 101 cm of Hg = 101/76 atm

12. **(a) :** Alkenes with odd number of double bonds are planar.

13. **(c, d)**

14. **(a, c) :** 

15. **(b, c, d)**

PRACTICE PAPER

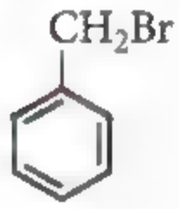
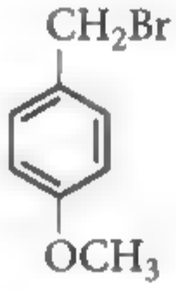
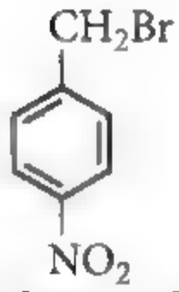
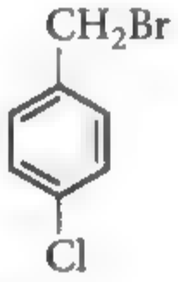
NEET

Exam on
3rd May 2020

1. In nitroprusside ion the iron and NO exist as Fe^{II} and NO^+ rather than Fe^{III} and NO. These forms can be differentiated by
   (a) estimating the concentration of iron
   (b) measuring the concentration of CN^-
   (c) measuring the solid state magnetic moment
   (d) thermally decomposing the compound.

2. If the bond energies of H–H, Br–Br, and H – Br are 433, 192 and 364 kJ mol^{-1} respectively, the ΔH° for the reaction, $H_{2\,(g)} + Br_{2\,(g)} \rightarrow 2HBr_{(g)}$ is
   (a) –261 kJ (b) +103 kJ
   (c) +261 kJ (d) –103 kJ.

3. Which of the following halides undergoes S_N1 reaction at the fastest rate?

   (a) 
   (b) 
   (c) 
   (d) 

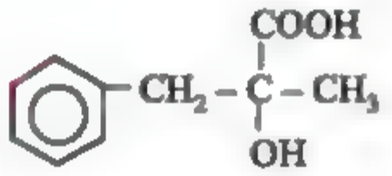
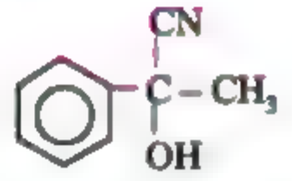
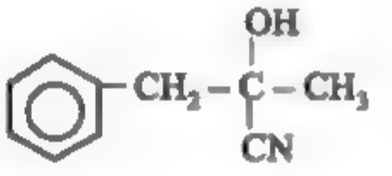
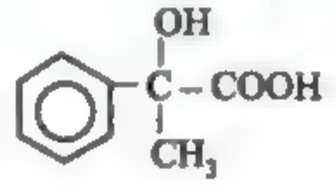
4. A solution of acetone in ethanol
   (a) obeys Raoult's law
   (b) shows a negative deviation from Raoult's law
   (c) shows a positive deviation from Raoult's law
   (d) behaves nearly like an ideal solution.

5. 2 N HCl solution will have same molar conc. as a
   (a) 4.0 N H_2SO_4 (b) 0.5 N H_2SO_4
   (c) 1 N H_2SO_4 (d) 2 N H_2SO_4

6. In the following reactions acetic acid yielded a product *D*.

   $$CH_3COOH \xrightarrow{SOCl_2} A \xrightarrow[\text{anhy. } AlCl_3]{\text{benzene}} B \xrightarrow{HCN} C \xrightarrow{HOH} D$$

   The structure of *D* would be

   (a) 
   (b) 
   (c) 
   (d) 

7. Which of the following represents the correct order of their increasing bond order?
   (a) $C_2^{2-} < He_2^+ < NO < O_2^-$
   (b) $He_2^+ < O_2^- < NO < C_2^{2-}$
   (c) $O_2^- < NO < C_2^{2-} < He_2^+$
   (d) $NO < C_2^{2-} < O_2^- < He_2^+$

8. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_2(SO_4)_3$?
   (a) $2\Lambda^\circ_{Al^{3+}} + 2\Lambda^\circ_{SO_4^{2-}}$ (b) $\Lambda^\circ_{Al^{3+}} + \Lambda^\circ_{SO_4^{2-}}$
   (c) $(\Lambda^\circ_{Al^{3+}} + \Lambda^\circ_{SO_4^{2-}}) \times 6$
   (d) $\frac{1}{3}\Lambda^\circ_{Al^{3+}} + \frac{1}{2}\Lambda^\circ_{SO_4^{2-}}$

9. H_2O is dipolar, whereas BeF_2 is not. It is because
   (a) the electronegativity of F is greater than that of O
   (b) H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule
   (c) H_2O is linear and BeF_2 is angular
   (d) H_2O is angular and BeF_2 is linear.

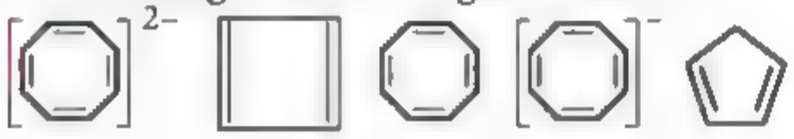
10. CsBr crystallises in a body centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 u and that of Br = 80 u and Avogadro number being 6.02×10^{23} mol^{-1}, the density of CsBr is
    (a) 4.25 g/cm^3 (b) 42.5 g/cm^3
    (c) 0.425 g/cm^3 (d) 8.25 g/cm^3.

11. Ozone is an important constituent of stratosphere because it
(a) destroys bacteria which are harmful to human life
(b) prevents the formation of smog over large cities
(c) removes poisonous gases of the atmosphere by reacting with them
(d) absorbs ultraviolet radiation which is harmful to human life.

12. Chargaff's rule states that in an organism
(a) amount of adenine (*A*) is equal to that of thymine (*T*) and the amount of guanine (*G*) is equal to that of cytosine (*C*)
(b) amount of adenine (*A*) is equal to that of guanine (*G*) and the amount of thymine (*T*) is equal to that of cytosine (*C*)
(c) amount of adenine (*A*) is equal to that of cytosine (*C*) and the amount of thymine (*T*) is equal to that of guanine (*G*)
(d) amounts of all bases are equal.

13. The straight chain polymer is formed by
(a) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation
(b) hydrolysis of $(CH_3)_4Si$ by addition polymerisation
(c) hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerisation
(d) hydrolysis of $(CH_3)_3SiCl$ followed by condensation polymerisation.

14. Which among the following is aromatic?



I II III IV V
(a) Only I (b) Only II and V
(c) Only III and I (d) Only IV

15. Formation of polyethylene from calcium carbide takes place as follows:

$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$
$$C_2H_2 + H_2 \longrightarrow C_2H_4$$
$$nC_2H_4 \longrightarrow +CH_2 - CH_2+_n$$

The amount of polyethylene obtained from 64 kg of CaC_2 is
(a) 7 kg (b) 14 kg (c) 21 kg (d) 28 kg

16. Equal masses of H_2, O_2 and methane have been taken in a container of volume *V* at temperature 27 °C in identical conditions. The ratio of the volumes of gases $H_2 : O_2$: methane would be
(a) 8 : 16 : 1 (b) 16 : 8 : 1
(c) 16 : 1 : 2 (d) 8 : 1 : 2

17. The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic conditions gives
(a) Mn^{4+} and O_2 (b) Mn^{2+} and O_2
(c) Mn^{2+} and O_3 (d) Mn^{4+} and MnO_2.

18. Match List I with List II and select the correct answer using the codes gives below the lists :

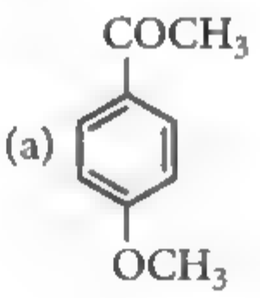
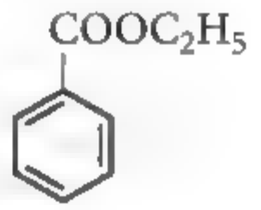
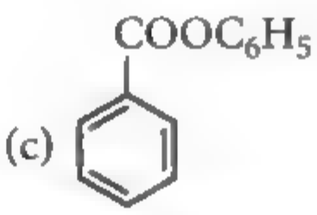
List I	List II
A. Iodoform	I. Anaesthetic
B. Methyl salicylate	II. Antiseptic
C. Diethyl ether	III. Insecticide
D. Hexachlorocyclohexane	IV. Detergent
	V. Pain balm

(a) A-II, B-V, C-III, D-IV
(b) A-IV, B-II, C-I, D-III
(c) A-II, B-V, C-I, D-III
(d) A-III, B-I, C-IV, D-II

19. Ozonolysis of 2, 3-dimethyl-1-butene followed by reduction with zinc and water gives
(a) methanoic acid and 3-methyl-2-butanone
(b) methanal and 2-methyl-2-butanone
(c) methanal and 3-methyl-2-butanone
(d) methanoic acid and 2-methyl-2-butanone.

20. In a zero-order reaction for every 10°C rise of temperature, the rate is doubled. If the temperature is increased from 10°C to 100°C, the rate of the reaction will become
(a) 256 times (b) 512 times
(c) 64 times (d) 128 times.

21. An ester $A(C_9H_{10}O_2)$ with excess of CH_3MgBr upon hydrolysis and then with conc. H_2SO_4 gives an olefin (*B*). Ozonolysis of (*B*) gave a ketone (C_8H_8O) which gave positive iodoform test. The structure of *A* is

(a) 
(b) 
(c) 
(d) 

22. Which of the following statements is not correct about control of particulate pollution?
(a) In electrostatic precipitator, the particulates are made to acquire positive charge which are then attracted by the negative electrode and removed.

(b) Gravity settling chamber removes larger particles from the air.
(c) Cyclone collector removes fine particles in the diameter range 5-20 microns.
(d) Wet scrubbers are used to wash away all types of particulates.

23. The e.m.f. of a Daniell cell at 298 K is E_1

$$Zn|ZnSO_4(0.01\,M)||CuSO_4(1.0\,M)|Cu$$

when the concentration of $ZnSO_4$ is 1.0 M and that of $CuSO_4$ is 0.01 M, the e.m.f. changed to E_2. What is the relationship between E_1 and E_2 ?
(a) $E_1 > E_2$ (b) $E_1 < E_2$
(c) $E_1 = E_2$ (d) $E_2 = 0 \neq E_1$

24. Which of the following is not permissible arrangement of electrons in an atom?
(a) $n = 5, l = 3, m = 0, s = +1/2$
(b) $n = 3, l = 2, m = -3, s = -1/2$
(c) $n = 3, l = 2, m = -2, s = -1/2$
(d) $n = 4, l = 0, m = 0, s = -1/2$

25. The correct order of the mobility of the alkali metal ions in aqueous solution is
(a) $Rb^+ > K^+ > Na^+ > Li^+$
(b) $Li^+ > Na^+ > K^+ > Rb^+$
(c) $Na^+ > K^+ > Rb^+ > Li^+$
(d) $K^+ > Rb^+ > Na^+ > Li^+$

26. Electronegativity of oxygen is more than sulphur yet H_2S is acidic while water is neutral. This is because
(a) water is highly associated compound
(b) molecular mass of H_2S is more than H_2O
(c) H_2S is gas while H_2O is a liquid
(d) H–S bond is weaker than H–O bond.

27. In a periodic table, the basic character of oxides
(a) increases from left to right and decreases from top to bottom
(b) decreases from right to left and increases from top to bottom
(c) decreases from left to right and increases from top to bottom
(d) decreases from left to right and increases from bottom to top.

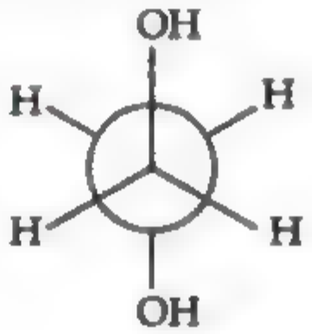
28. Among the following, the pair in which the two species are not isostructural is
(a) SiF_4 and SF_4 (b) IO_3^- and XeO_3
(c) BH_4^- and NH_4^+ (d) PF_6^- and SF_6.

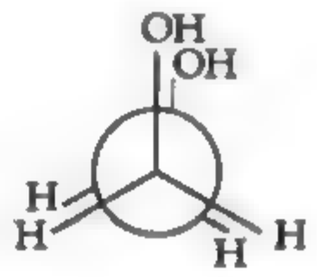
29. If in a pair of immiscible liquids, a common solute dissolves in both and equilibrium is reached, then the concentration of the solute in the upper layer is
(a) zero
(b) in fixed ratio with that in the lower layer
(c) lower than that in the lower layer
(d) higher than that in the lower layer.

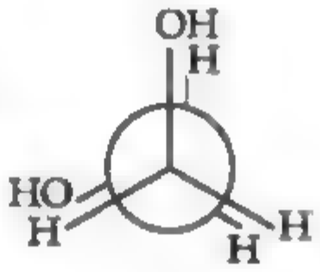
30. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.80 g mL^{-1}. Volume of acid required to make one litre of 0.1 M H_2SO_4 solution is
(a) 16.65 mL (b) 22.20 mL
(c) 5.55 mL (d) 11.10 mL.

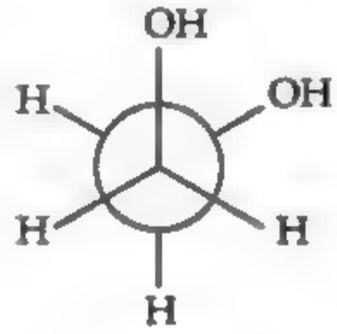
31. Which of the following statements is not correct about Ellingham diagram?
(a) ΔG increases with an increase in temperature.
(b) It consists of plots of $\Delta_f G^\circ$ vs T for formation of oxides.
(c) A coupling reaction can be well expressed by this diagram.
(d) It express the kinetics of the reduction process.

32. Which of the following conformers for ethylene glycol is most stable?

(a) 

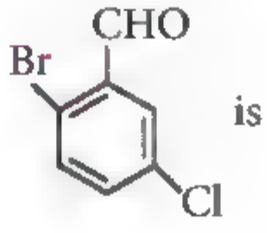
(b) 

(c) 

(d) 

33. $[Cr(H_2O)_6]Cl_3$ (at. no. of Cr = 24) has a magnetic moment of 3.83 B.M. The correct distribution of 3*d* electrons in this chromium complex is
(a) $3d^1_{xy}, 3d^1_{yz}, 3d^1_{z^2}$
(b) $3d^1_{(x^2-y^2)}, 3d^1_{z^2}, 3d^1_{xz}$
(c) $3d^1_{xy}, 3d^1_{(x^2-y^2)}, 3d^1_{yz}$
(d) $3d^1_{xy}, 3d^1_{yz}, 3d^1_{xz}$

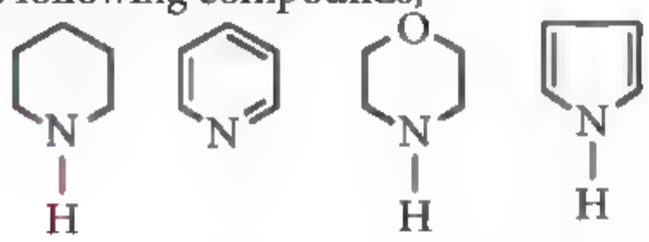
34. The correct IUPAC name of the given compound



is

(a) *o*-bromo-*p*-chlorobenzaldehyde
(b) 2-bromo-5-chlorobenzaldehyde
(c) 6-bromo-3-chlorobenzaldehyde
(d) 1-bromo-4-chlorobenzaldehyde.

35. In the following compounds,



I II III IV

the order of basicity is
(a) IV > I > III > II (b) III > I > IV > II
(c) II > I > III > IV (d) I > III > II > IV

36. The temperature dependence of rate constant (k) of a chemical reaction is written in terms of Arrhenius equation, $k = A \cdot e^{-E_a/RT}$. Activation energy (E_a) of the reaction can be calculated by plotting

(a) k vs T (b) k vs $\frac{1}{\log T}$

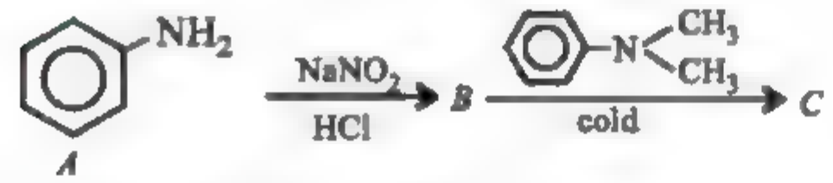
(c) $\log k$ vs $\frac{1}{T}$ (d) $\log k$ vs $\frac{1}{\log T}$

37. A compound is soluble in conc. H_2SO_4. It does not decolourise bromine in carbon tetrachloride but is oxidised by chromic anhydride in aqueous sulphuric acid within two seconds, turning orange solution to blue, green and then opaque. The original compound is
(a) a primary alcohol (b) a tertiary alcohol
(c) an alkane (d) an ether.

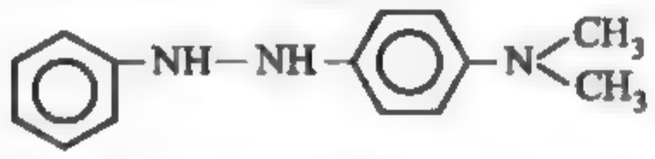
38. Which of the following structures is similar to graphite?
(a) B_4C (b) B_2H_6 (c) BN (d) B

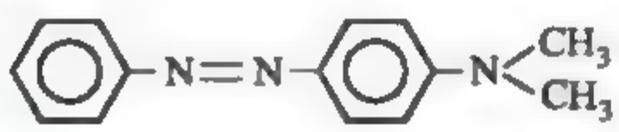
39. Among the following which is not the π-bonded organometallic compound?
(a) $K[PtCl_3(\eta^2 - C_2H_4)]$
(b) $Fe(\eta^5 - C_5H_5)_2$
(c) $Cr(\eta^6 - C_6H_6)_2$ (d) $(CH_3)_4Sn$

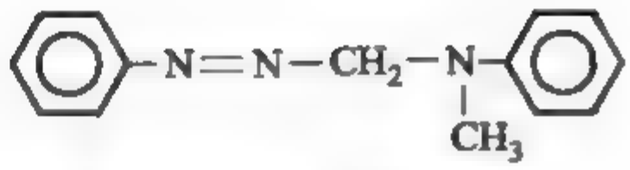
40. In a reaction of aniline, a coloured product *C* was obtained.

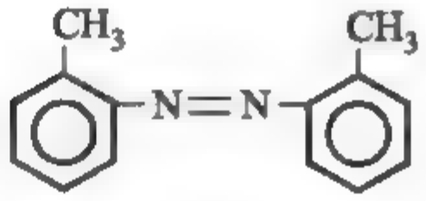


The structure of *C* would be

(a) 

(b) 

(c) 

(d) 

41. The rapid change of pH near the stoichiometric point of an acid-base titration is the basis of indicator detection. pH of the solution is related to ratio of the concentrations of the conjugate acid (HIn) and base (In^-) forms of the indicator by the expression

(a) $\log\frac{[In^-]}{[HIn]} = pK_{In} - pH$

(b) $\log\frac{[HIn]}{[In^-]} = pK_{In} - pH$

(c) $\log\frac{[HIn]}{[In^-]} = pH - pK_{In}$

(d) $\log\frac{[In^-]}{[HIn]} = pH - pK_{In}$

42. For vaporization of water at 1 atmospheric pressure, the values of ΔH and ΔS are 40.63 kJ mol^{-1} and 108.8 JK^{-1} mol^{-1}, respectively. The temperature when Gibbs' energy change (ΔG) for this transformation will be zero, is
(a) 273.4 K (b) 393.4 K
(c) 373.4 K (d) 293.4 K

43. The ions O^{2-}, F^-, Na^+, Mg^{2+} and Al^{3+} are isoelectronic. Their ionic radii show
(a) a significant increase from O^{2-} to Al^{3+}
(b) a significant decrease from O^{2-} to Al^{3+}
(c) an increase from O^{2-} to F^- and then decrease from Na^+ to Al^{3+}
(d) a decrease from O^{2-} to F^- and then increase from Na^+ to Al^{3+}.

44. The increasing oxidation states of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order
(a) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
(b) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$
(c) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$
(d) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$

45. A 0.1 molal solution of a weak acid is 45% ionized. Calculate depression in freezing point. (Molecular weight of the acid is 300, $K_f = 1.86$ K mol^{-1} kg.)
(a) – 0.199°C (b) 2.00°C
(c) 0°C (d) – 0.269°C

SOLUTIONS

1. (c)

2. (d) : H–H + Br–Br → 2H–Br

Bond Energy (kJ mol^{-1})	433	192	2 × 364

Net energy released = $\Sigma H_R - \Sigma H_P$
= (433 + 192) – 2 × 364
= 625 – 728 = –103 kJ

3. (b) : Resonance stabilisation of

intermediate is more due to +*M* effect of $CH_3\ddot{O}$– group.

4. (c) : Both the components escape easily showing higher vapour pressure than the expected value.

5. (a) : From the relation

$$\frac{\text{Normality}}{\text{Molarity}} = \frac{\text{Molecular mass}}{\text{Equivalent mass}} = n$$

For 2 N HCl,

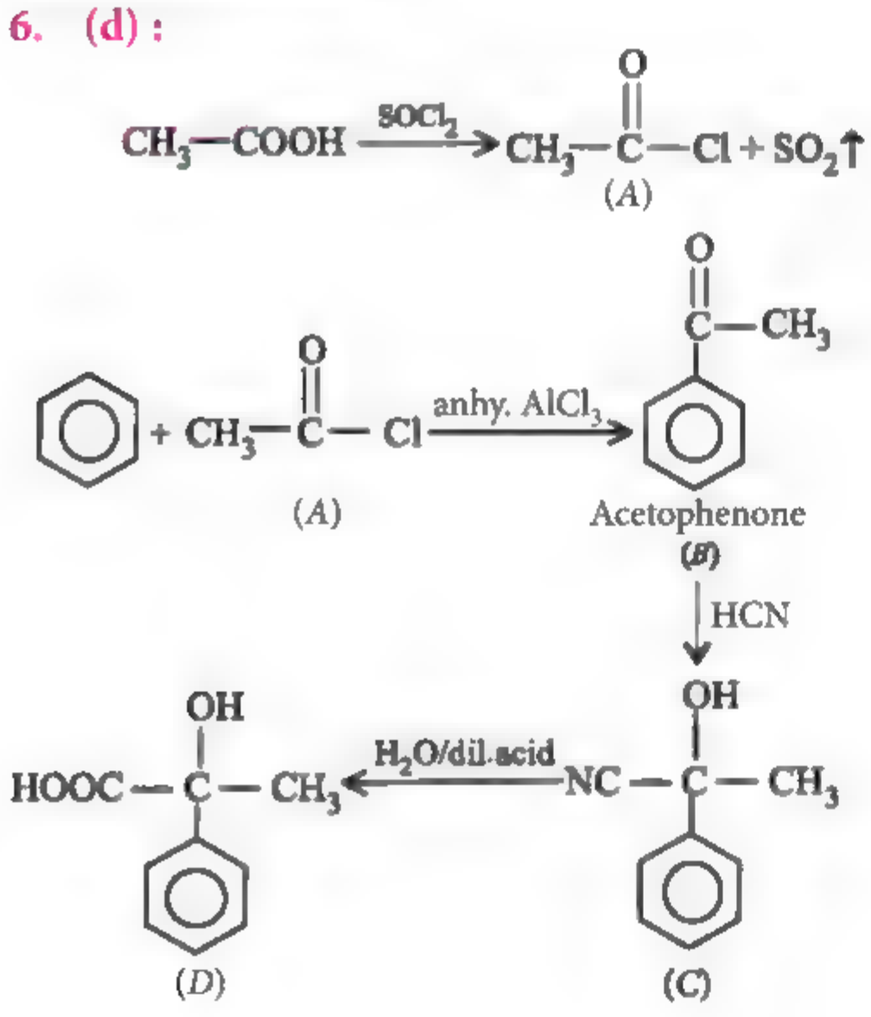
$$\text{Molarity} = \frac{\text{Normality} \times \text{Equivalent weight}}{\text{Molecular weight}}$$

$$\text{Molarity} = \frac{2 \times 36.5}{36.5} = 2$$

For 4 N H_2SO_4, $\text{Molarity} = \frac{4 \times 49}{98} = 2$

Hence, 4 N H_2SO_4 and 2 N HCl solution will have same molar concentration.

6. (d) :



7. (b) : According to molecular orbital theory, the energy level of the given molecules are

$C_2^{2-} \rightarrow \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \pi 2p_x^2\ \pi 2p_y^2\ \sigma 2p_z^2$

B.O. = 1/2[10 – 4] = 3

$He_2^+ \rightarrow \sigma 1s^2\ \sigma^* 1s^1$

B.O. = 1/2[2 – 1] = 1/2 = 0.5

$NO \rightarrow \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2\ \pi 2p_y^2\ \pi^* 2p_x^1$

B.O. = 1/2[10 – 5] = 2.5

$O_2^- \rightarrow \sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2\ \pi 2p_y^2\ \pi^* 2p_x^2\ \pi^* 2p_y^1$

B.O. = 1/2[10 – 7] = 1.5

So, the correct order of their increasing bond order is

$He_2^+ < O_2^- < NO < C_2^{2-}$

8. (b)

9. (d)

10. (a) : Density of CsBr = $\frac{Z \times M}{V \times N_A}$

$$= \frac{1 \times 213}{(436.6 \times 10^{-10})^3 \times 6.023 \times 10^{23}} = 4.25\ \text{g/cm}^3$$

11. (d) : Ozone absorbs U.V. radiations harmful to human life.

12. (a)

13. (c)

14. (a) : Only structure I has 8 + 2 = 10 π electrons, hence it is aromatic; II has 4, III has 8, IV has 9 and V has 4 electrons hence, are not aromatic.

15. (d) : The concerned chemical reactions are

$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$

64 kg — Ethyne, 26 kg

$C_2H_2 + H_2 \rightarrow C_2H_4$

Ethylene, 28 kg

$nC_2H_4 \rightarrow +CH_2-CH_2+_n$

$n \times 28$ kg or 28 kg — $n \times 28$ kg polythene or 28 kg

16. (c) : No. of moles = $\frac{\text{Mass}}{\text{Mol. mass}}$

$n_{H_2} = \frac{w}{2};\ n_{O_2} = \frac{w}{32};\ n_{CH_4} = \frac{w}{16}$

So, the ratio is $\frac{w}{2} : \frac{w}{32} : \frac{w}{16}$ or 16:1:2

17. (b) : Hydrogen peroxide is oxidised to H_2O and O_2.

$2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \longrightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

or, $2MnO_4^- + 5H_2O_2 + 6H^+ \longrightarrow 2Mn^{2+} + 8H_2O + 5O_2$

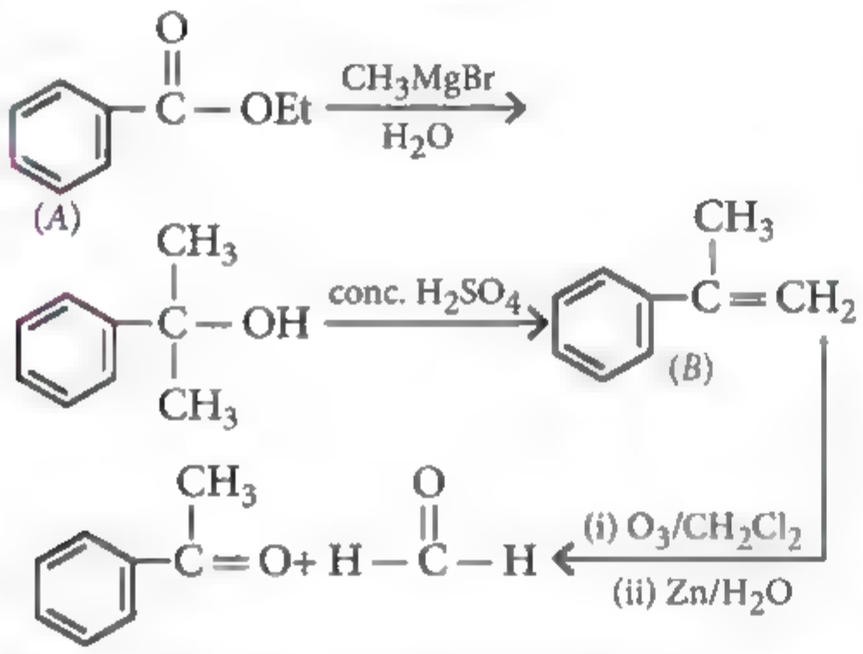
18. (c)

19. (c) : $CH_2=C(CH_3)-CH(CH_3)$ (2, 3–Dimethyl–1–butene) $\xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3,\ CH_2Cl_2}$ $HCHO$ (Methanal) + $CH_3-C(=O)-CH(CH_3)-CH_3$ (3–Methyl–2–butanone)

20. (b) : At 10°C rise, rate increases by 2.

$$\frac{r_{100°C}}{r_{10°C}} = 2^{\left(\frac{100-10}{10}\right)} = 2^9 = 512 \text{ times}$$

21. (b) :



All methyl ketones give positive iodoform test.

22. (a) : Particulates acquire negative charge and are attracted by the positively charged electrode.

23. (a) : Cell reaction can be represented as

$$Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$$

Applying Nernst equation,

$$E_1 = E^\circ_{cell} - \frac{0.059}{2}\log\frac{0.01}{1}$$

when conc. of $ZnSO_4$ and $CuSO_4$ are changed

$$E_2 = E^\circ_{cell} - \frac{0.059}{2}\log\frac{1}{0.01}. \text{ So, } E_1 > E_2$$

24. (b) : This is not possible, as values of m_l which are possible for $l = 2$ are –2, –1, 0, +1 and +2 only.

25. (a)

26. (d) : S—H bond is weaker than O—H bond. Hence, H_2S will furnish H^+ ions easily.

27. (c) **28. (a)** **29. (b)**

30. (c) : H_2SO_4 is 98% by weight.

Weight of H_2SO_4 = 98 g ; Weight of solution = 100 g

$$\therefore \text{ Volume of solution} = \frac{\text{mass}}{\text{density}} = \frac{100}{1.80} \text{ mL}$$

$$= 55.55 \text{ mL} = 0.0555 \text{ L}$$

$$\text{Molarity of solution} = \frac{98}{98\times0.0555} \text{ M} = 18.02 \text{ M}$$

Let V_1 mL of this H_2SO_4 are used to prepare 1 litre of 0.1 M H_2SO_4.

$\therefore$ mmol of conc.H_2SO_4 = mmol of dil. H_2SO_4

or $M_1V_1 = M_2V_2$

$$V_1 \times 18.02 = 1000 \times 0.1 \text{ ; } V_1 = \frac{1000\times0.1}{18.02} = 5.55 \text{ mL}$$

31. (d)

32. (d) : The conformation (d) is most stable because of intramolecular H-bonding.

33. (d) : Magnetic moment, $\mu = \sqrt{n(n+2)}$

$3.83 = \sqrt{n(n+2)}$ or, $(3.83)^2 = n(n+2)$

or, $14.6689 = n^2 + 2n$

On solving the equation, $n \approx 3$.

$Cr^{3+} \rightarrow [Ar]\ 3d^3$; ↑ ↑ ↑ | | (orbitals: d_{xy} d_{yz} d_{zx} $d_{x^2-y^2}$ d_{z^2})

34. (b)

35. (d)

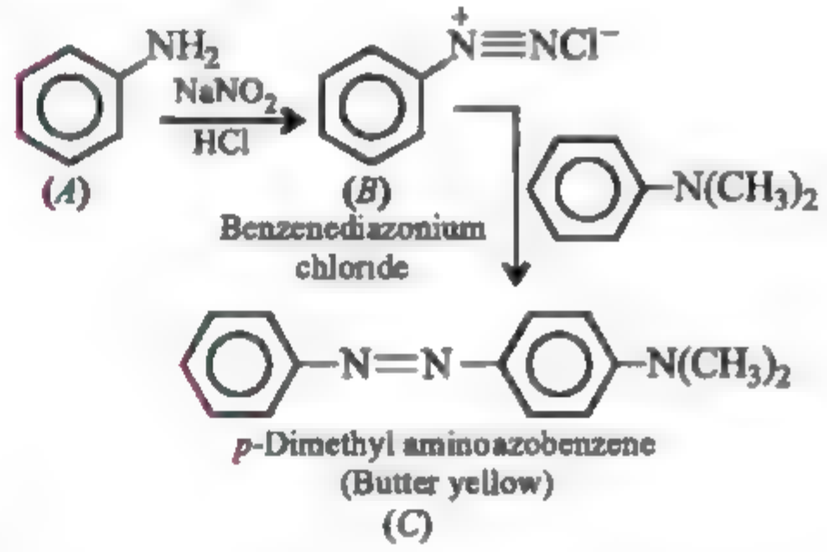
36. (c) : On plotting log$k$ vs $1/T$, we get a straight line, the slope indicates the value of activation energy.

37. (a)

38. (c) : BN is known as inorganic graphite and has structure similar to graphite.

39. (d)

40. (b) :



41. (d)

42. (c) : According to Gibb's equation, $\Delta G = \Delta H - T\Delta S$ when $\Delta G = 0$, $\Delta H = T\Delta S$

Given, $\Delta H = 40.63 \text{ kJ mol}^{-1} = 40.63 \times 10^3 \text{ J mol}^{-1}$

$\Delta S = 108.8 \text{ J K}^{-1} \text{ mol}^{-1}$

$$\therefore T = \frac{\Delta H}{\Delta S} = \frac{40.63\times10^3}{108.8} = 373.43 \text{ K}$$

43. (b) : For isoelectronic species, ionic radii decrease as the charge on species increase. So, ionic radii decrease from O^{2-} to Al^{3+}.

44. (a) : $\overset{+3}{S_2}O_4^{2-} < \overset{+4}{S}O_3^{2-} < \overset{+5}{S_2}O_6^{2-}$

45. (d) : If acid is 45% ionized then $\alpha = 0.45$.

As, $i = 1 + \alpha = 1.45$

$\Delta T_f = iK_fm = 1.45 \times 1.86 \times 0.1 = -0.269$ °C

CHEMISTRY MUSING

SOLUTION SET 78

1. **(d):** $K_p = \dfrac{P_{SO_3}^2}{P_{SO_2}^2 \cdot P_{O_2}} = \dfrac{(x_{SO_3}P)^2}{(x_{SO_2}P)^2(x_{O_2}P)}$

$$= \frac{(x_{SO_3})^2}{(x_{SO_2})^2(x_{O_2}P)}$$

where, x is mole fraction and P is the total pressure.

$$\therefore \quad K_p = \frac{(n_{SO_3})^2 n_{Total}}{(n_{SO_2})^2 n_{O_2}} \times \frac{1}{P} \qquad \left(\because\ x = \frac{n}{n_{Total}}\right)$$

Since, for an ideal gas mixture, $PV = n_{Total}RT$,

$$\therefore \quad K_p = \frac{(n_{SO_3})^2}{(n_{SO_2})^2 n_{O_2}} \times \left(\frac{V}{RT}\right) \qquad ...(i)$$

Let y be the number of moles of O_2 reacted at equilibrium. Then,

$$\underset{(0.1-2y)}{2SO_{2(g)}} + \underset{y}{O_{2(g)}} \rightleftharpoons \underset{(0.1+2y)}{2SO_{3(g)}}$$

$\therefore \quad n_{Total} = (0.1 - 2y) + y + (0.1 + 2y) = 0.2 + y$

Also, $n_{Total} = \dfrac{PV}{RT}$

$$= \frac{(2.78\ atm)(2\ dm^3)}{(0.08206\ dm^3\ atm\ K^{-1}mol^{-1})(300\,K)} = 0.226\ mole$$

Thus, $0.226 = 0.2 + y \Rightarrow y = 0.026$ mole

Substituting the value of y in eq. (i), we have

$$K_p = \frac{(0.1+2y)^2}{(0.1-2y)^2 y}\left(\frac{V}{RT}\right)$$

$$= \frac{(0.152\ mol)^2(2\ dm^3)}{[(0.048\ mol)^2(0.026\ mol)(0.08206\ dm^3\ atm\ K^{-1}\ mol^{-1})(300\,K)]} = 31.33\ atm^{-1}$$

2. **(b):** During Kolbe's electrolysis reactions,

$$2RCOO^-Na^+ \rightleftharpoons R-\overset{\overset{O}{\|}}{C}-O^- + 2Na^+$$

At anode :

$$2R-\overset{\overset{O}{\|}}{C}-O^- \longrightarrow 2R-\overset{\overset{O}{\|}}{C}-O^\bullet + 2e^-$$

$$2R^\bullet + 2CO_2\uparrow \longleftarrow R-R$$

Alkane

At cathode :

$H_2O \rightleftharpoons H^+ + OH^-$

Reduction potential of $H^+ > Na^+$. So H^+ from H_2O migrate towards cathode.

$2H^+ + 2e^- \longrightarrow 2H^\bullet \longrightarrow H_2\uparrow$

NaOH is formed as side product. So, during reaction, pH of medium increases.

3. **(d):** $Cl_2 + 2I^- \longrightarrow 2Cl^- + I_2$

$Cl_2 + 2Br^- \longrightarrow Br_2 + 2Cl^-$

Oxidizing power : $Cl_2 > Br_2 > I_2$

Hence, Cl_2 oxidises I^- first to I_2 which gives violet colour in CCl_4, then Br^- to Br_2, which gives brown colour in CCl_4, finally I_2 is oxidised to IO^-. Hence, the CCl_4 layer turns colourless.

4. **(d):** Enthalpy of hydrogenation of cyclohexene ;


$= -119.5\ kJ\ mol^{-1}$

$\therefore$ Calculate enthalpy of hydrogenation of benzene ;


$= 3(-119.5)\ kJ\ mol^{-1} = -358.5\ kJ\ mol^{-1}$

As actual value is lower by amount equal to resonance energy, therefore actual enthalpy of hydrogenation

$= -358.5\ kJ\ mol^{-1} - (-150.4\ kJ\ mol^{-1})$

$= -208.1\ kJ\ mol^{-1}$

5. **(a):** Specific conductance, κ = cell constant/R,

$\therefore$ cell constant $= \kappa R = (0.277\ S\ m^{-1})\ (250\ \Omega)$

$= 69.2\ m^{-1} \quad (\because S = \Omega^{-1})$

For NH_4OH solution, $c = 6 \times 10^{-5}$ M

$= 6 \times 10^{-5}\ mol\ dm^{-3} = 6 \times 10^{-2}\ mol\ m^{-3}$

$$\Lambda_m = \frac{\kappa}{C} = \frac{\text{cell constant}}{CR} = \frac{69.2\ m^{-1}}{(6\times10^{-2}\ mol\ m^{-3})\,(10^5\,\Omega)}$$

$= 115 \times 10^{-4}\ S\ m^2\ mol^{-1}$

According to Kohlrausch's law,

$\Lambda_m^\circ = \lambda_+^\circ + \lambda_-^\circ = (73.4 + 198.0) \times 10^{-4}\ S\ m^2\ mol^{-1}$

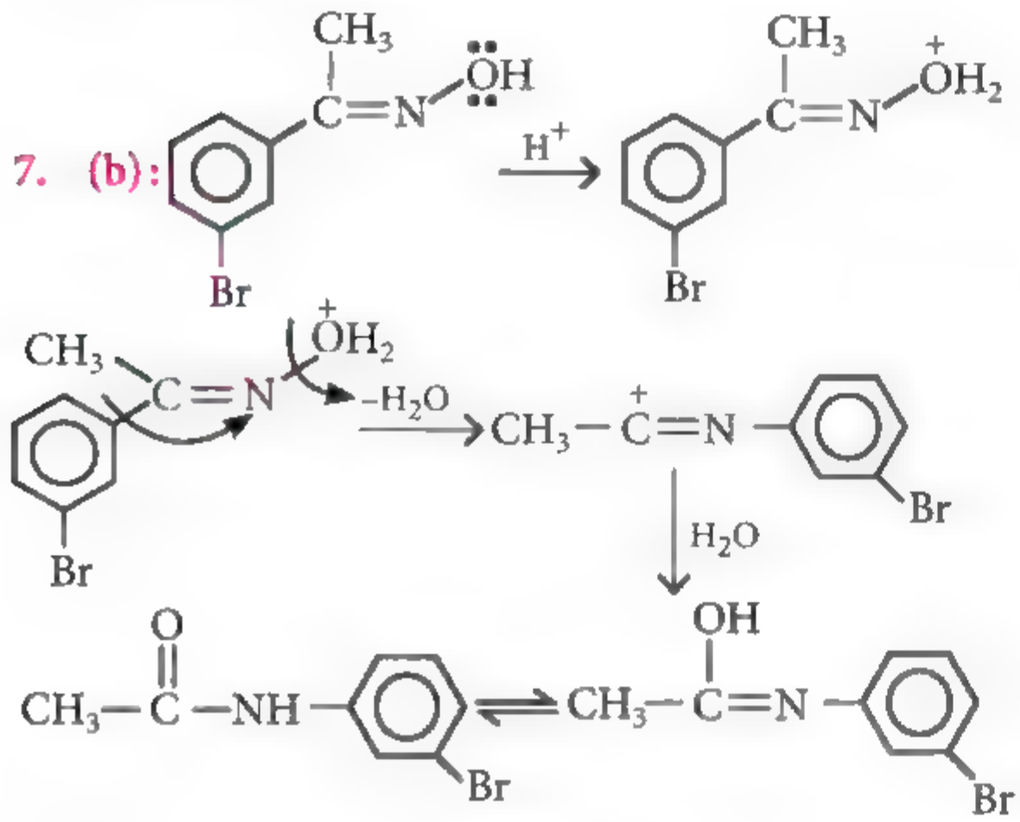
$= 271.4 \times 10^{-4}\ S\ m^2\ mol^{-1}$

$$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ} = \frac{115\times10^{-4}\ S\ m^2\ mol^{-1}}{271.4\times10^{-4}\ S\ m^2\ mol^{-1}} = 0.424$$

6. **(b, c, d):** In *d*-block elements, group 6, Mo (VI) and W(VI) are found to be more stable than Cr (VI). Copper (I) compounds are unstable in aqueous solution and undergo disproportionation.

E° of Zn^{2+}/Zn is more negative than expected due to the removal of an electron from the stable d^{10} configuration of Zn^{2+}. The E° values for the redox couple M^{3+}/M indicates that Mn^{3+} and Co^{3+} ions are the strongest oxidizing agents in aqueous solutions.

7. (b):



9. (0.13) : Let a g of sample is weighed out for the analysis.

$$\text{Wt. of NaCl} = \frac{60}{100} \times a = 0.6a \text{ g}$$

$$\text{Wt. of KCl} = \frac{37}{100} \times a = 0.37a \text{ g}$$

Now this mixture reacts with $AgNO_3$, the excess of $AgNO_3$ is back titrated with NH_4SCN.

Meq. of $AgNO_3$ added to mixture = $25 \times 0.1 = 2.5$

Normality of NH_4SCN can be derived as :

Meq. of NH_4SCN = Meq. of $AgNO_3$

$N \times 1 = 0.1 \times 1.1$

$N = 0.11$

Meq. of $AgNO_3$ left = Meq. of $NH_4SCN = 5 \times N$

Meq. of $AgNO_3$ left = $5 \times 0.11 = 0.55$

Meq. of $AgNO_3$ used for mixture = $2.5 - 0.55 = 1.95$

Meq. of KCl + Meq. of NaCl in mixture = 1.95

$$\frac{0.37a}{74.5} \times 1000 + \frac{0.6a}{58.5} \times 1000 = 1.95$$

$a = 0.128$ g

10. (421.9) : Case I, at 300 K :

Let pressure in upper part be P_1 and in lower part be P_2. Also P_0 is pressure of piston.

At equilibrium, $P_2 = P_0 + P_1$ ...(i)

Let volume of cylinder be V litre

Volume of upper part = $\frac{4V}{5}$

and, volume of lower part = $\frac{V}{5}$

Also in the two parts of cylinder, each part contains 1 mole at 300 K and thus,

$$P_1 \times \frac{4V}{5} = P_2 \times \frac{V}{5}$$

$$\therefore \quad \frac{P_2}{P_1} = 4 \qquad \text{...(ii)}$$

By eqn (i)and (ii), $P_1 = \frac{P_0}{3}$ ...(iii)

Case II, at T K :

Now the temperature becomes T at which volume of upper part is $\frac{3V}{4}$ and lower part is $\frac{V}{4}$.

Again, $P'_1 \times \frac{3V}{4} = P'_2 \times \frac{V}{4}$

$$\therefore \quad \frac{P'_2}{P'_1} = 3 \qquad \text{...(iv)}$$

By eqns (i) and (iv), $P'_1 = \frac{P_0}{2}$ ...(v)

Now using, $PV = nRT$ for upper parts of cylinder at 300 K and T K.

$P_1 \times \frac{4V}{5} = 1 \times R \times 300$; Case I upper part

$P'_1 \times \frac{3V}{4} = 1 \times R \times T$; Case II upper part

$$\therefore \quad \frac{P_1}{P'_1} \times \frac{16}{15} = \frac{300}{T} \qquad \text{...(vi)}$$

Using eqns. (iii) and (v) in eqn (vi), $\frac{2}{3} \times \frac{16}{15} = \frac{300}{T}$

$$T = \frac{300 \times 3 \times 15}{2 \times 16} = 421.875 \text{ K}$$

GET SET GO for JEE

Class XII

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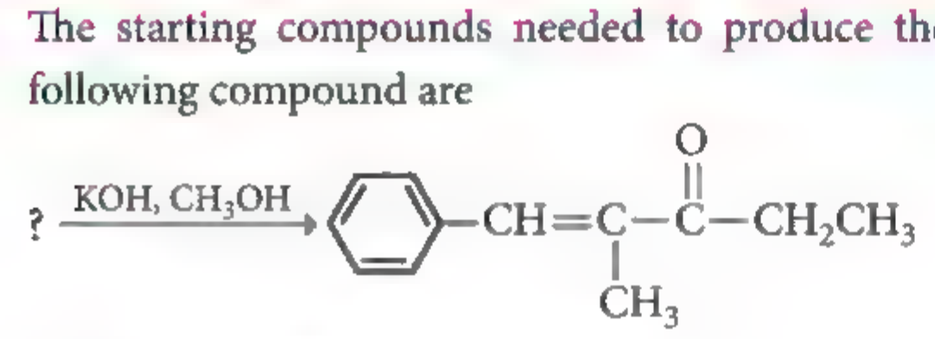
Only One Option Correct Type

1. The starting compounds needed to produce the following compound are



(a) benzaldehyde and 3-pentanone
(b) acetophenone and 2-butanone
(c) acetophenone and butanal
(d) benzaldehyde and 2-pentanone.

2. The dispersed phase, dispersion medium and the nature of colloidal solution of gold sol respectively are
(a) solid, solid and lyophobic
(b) liquid, liquid and lyophobic
(c) solid, liquid and lyophobic
(d) solid, liquid and lyophilic.

3. For the given reactions,

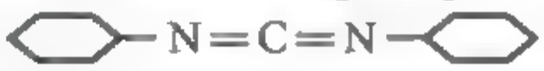
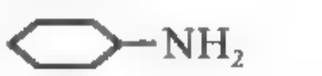
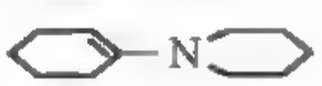
I. $CH_3CH=CHCH_3 + HI \xrightarrow{CH_3COOH} CH_3CH_2CHICH_3$

II. $CH_3CH_2CHICH_3 + NaOH_{(aq)} \rightarrow CH_3CH_2CH(OH)CH_3$

Type of reactions I and II respectively are
(a) electrophilic addition and electrophilic substitution reaction
(b) electrophilic addition and nucleophilic substitution reaction
(c) nucleophilic addition and electrophilic substitution reaction
(d) nucleophilic addition and free radical substitution reaction.

4. In the metal carbonyls of general formula $M(CO)_x$ (which follows Effective Atomic Number (EAN) rule) if M is Ni, Fe and Cr the value of x will be respectively
(a) 6, 5, 6 (b) 4, 5, 6 (c) 4, 4, 5 (d) 4, 6, 6

5. $KMnO_4$ is a strong oxidizing agent in acidic medium. To provide acidic medium, H_2SO_4 is used instead of HCl. This is because
(a) H_2SO_4 is a stronger acid than HCl
(b) HCl is oxidised by $KMnO_4$ to Cl_2
(c) H_2SO_4 is a dibasic acid
(d) rate is faster in the presence of H_2SO_4.

6. Which of the following compounds is an enamine?
(a) 
(b) 
(c) 
(d) 

7. If extent of dissociation of both KCl and $BaCl_2$ of same concentrations with identical value of α is 0.95, what is the ratio of their van't Hoff factors?
(a) 1.95 : 2.9 (b) 1.89 : 1
(c) 1 : 2.21 (d) 2.11 : 1

8. Anode mud obtained after electrolytic refining of copper contains
(a) Ag (b) Au
(c) Pt (d) all of these.

9. Polyvinyl alcohol can be prepared by
(a) polymerisation of vinyl alcohol
(b) alkaline hydrolysis of polyvinyl acetate
(c) polymerisation of acetylene
(d) reaction of acetylene with H_2SO_4 in presence of $HgSO_4$.

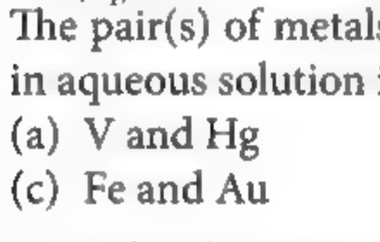
10. The non-stoichiometric iron oxide has a composition $Fe_{0.94}O$. What would be the ratio of ferrous and ferric ions present in it ?
(a) 32. : 5 (b) 41 : 6 (c) 37 : 4 (d) 43 : 5

More Than One Options Correct Type

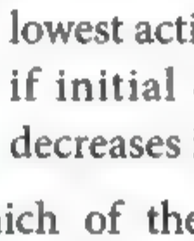
11. For the reduction of NO_3^- ion in an aqueous solution, E° is +0.96 V. Values of E° for some metal ions are given below :
$V^{2+}_{(aq)} + 2e^- \rightarrow V$; $E^\circ = -1.19$ V
$Fe^{3+}_{(aq)} + 3e^- \rightarrow Fe$; $E^\circ = -0.04$ V
$Au^{3+}_{(aq)} + 3e^- \rightarrow Au$; $E^\circ = +1.40$ V
$Hg^{2+}_{(aq)} + 2e^- \rightarrow Hg$; $E^\circ = +0.86$ V
The pair(s) of metals that is(are) oxidised by NO_3^- in aqueous solution is(are)
(a) V and Hg (b) Hg and Fe
(c) Fe and Au (d) Fe and V.

12. Consider the oxoacids of $HClO_n$ series, here value of n is 1 to 4. Then correct statements regarding these oxo acids are
(a) acidic character of oxoacids increases with increasing value of n.
(b) oxidising power of oxoacids increases with decreasing value of n.
(c) thermal stability of oxoacids decreases with increasing value of n.
(d) Cl—O bond order decreases with decreasing value of n.

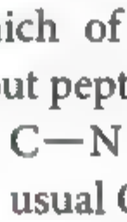
13. In the reaction,

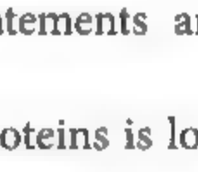


the intermediate(s) is (are)

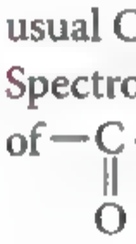
(a) 

(b) 

(c) 

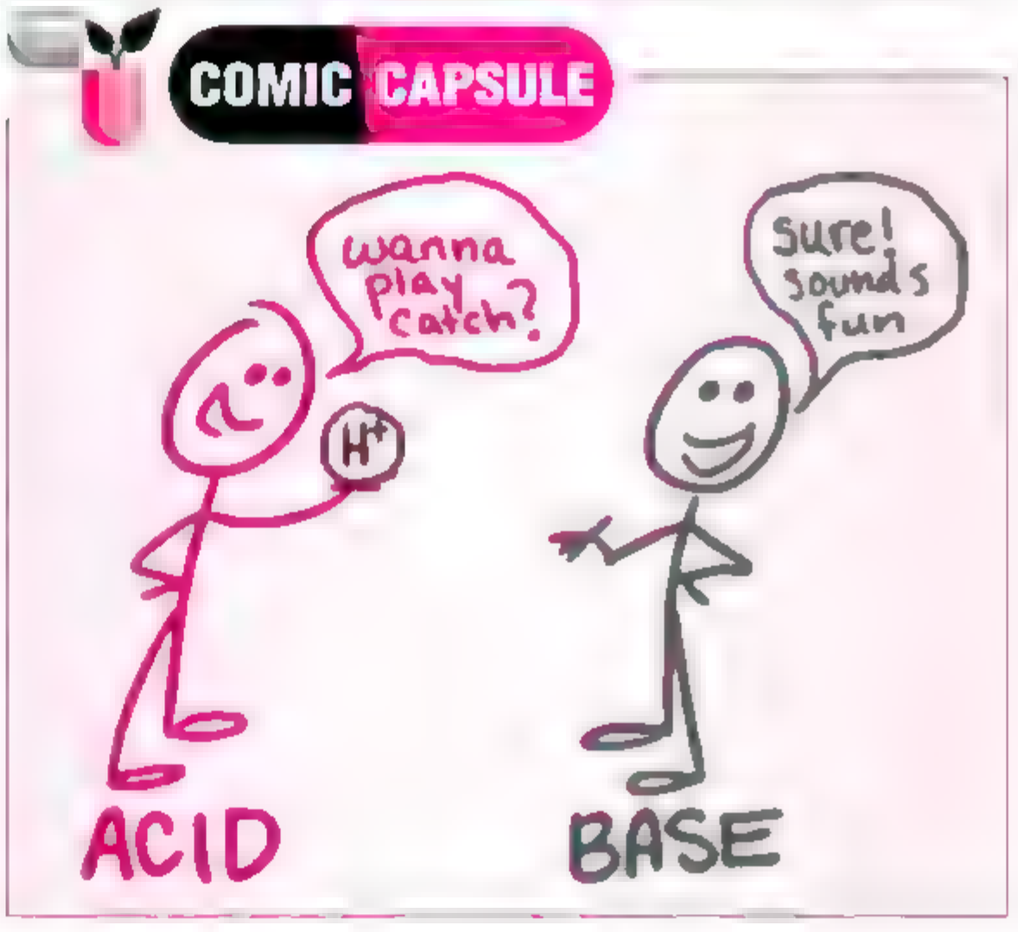
(d) 

14. The correct statements among the following are
(a) effective collisions are more if activation energy is less.
(b) zero order reaction proceeds at a constant rate independent of concentration or time.
(c) reactions with highest rate constant value have lowest activation energies.
(d) if initial concentration increases half-life decreases in zero order.

15. Which of the following statements are correct about peptide bond?
(a) C—N bond length in proteins is longer than usual C—N bond length.
(b) Spectroscopic analysis shows planar structure of  bond.

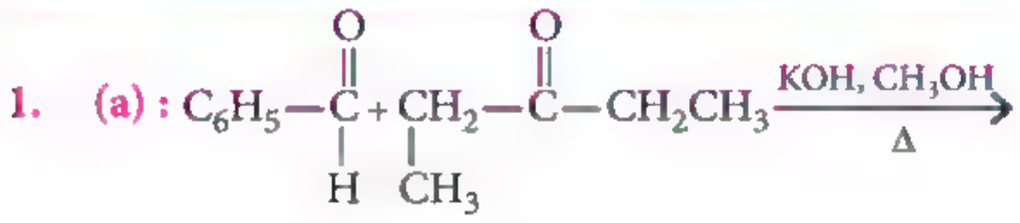
(c) C—N bond length in proteins is smaller than usual C—N bond length.
(d) Three peptide linkages form tripeptide.

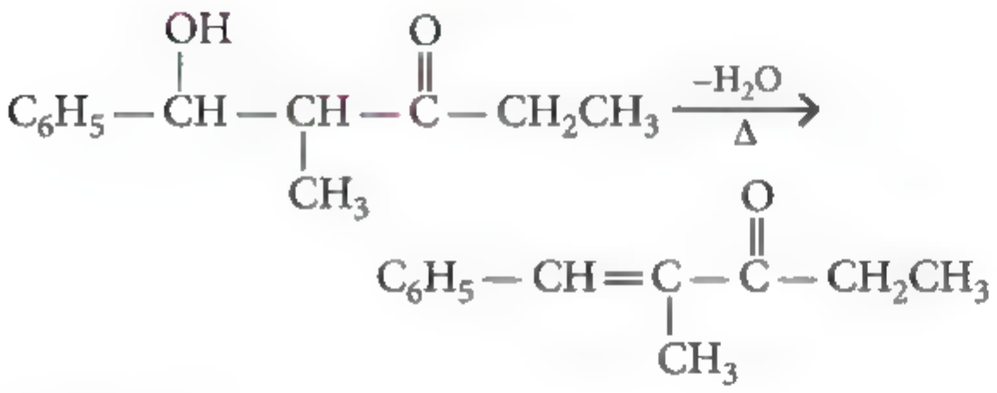
COMIC CAPSULE



SOLUTIONS

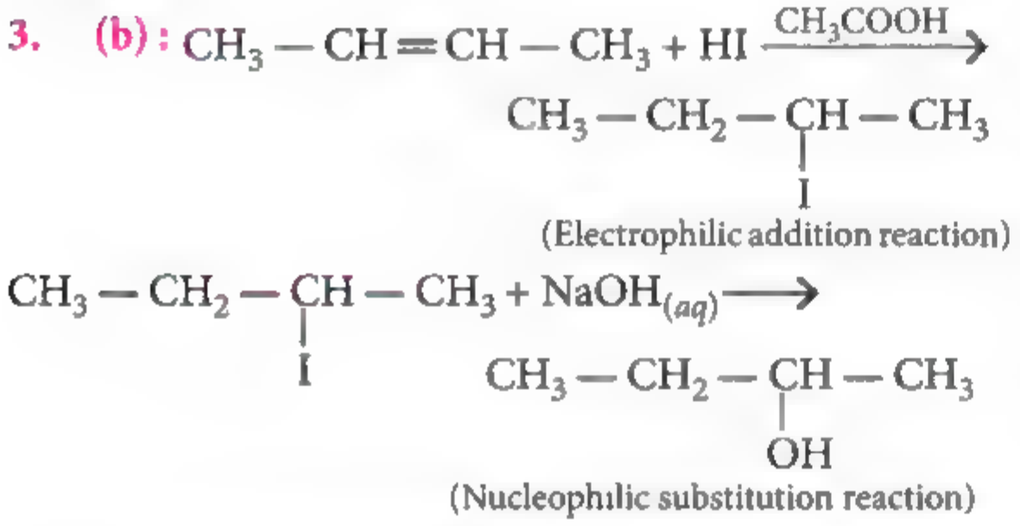
1. (a) :





2. (c)

3. (b) :



(Electrophilic addition reaction)

(Nucleophilic substitution reaction)

4. (b) : $M(CO)_x$ follows EAN rule.

EAN = Atomic no. of metal – oxidation state of metal + 2 × coordination no. (C.N.) of metal

or $\text{C.N.} = \dfrac{\text{EAN} - \text{At. No.} + \text{O.S}}{2}$

$\text{C.N. of Ni} = \dfrac{36-28+0}{2} = 4$

$\text{C.N. of Fe} = \dfrac{36-26+0}{2} = 5$

$\text{C.N. of Cr} = \dfrac{36-24+0}{2} = 6$

5. (b) : $KMnO_4$ oxidises HCl to Cl_2.

6. (c) : Enamines are unsaturated compounds derived by the coordination of an aldehyde or ketone with secondary amines.

7. (a) : $KCl \longrightarrow \underset{\alpha}{K^+} + \underset{\alpha}{Cl^-}$

$\underset{(1-\alpha)}{}$

$i = 1 - \alpha + \alpha + \alpha = 1 + \alpha = 1 + 0.95 = 1.95$

$BaCl_2 \longrightarrow \underset{\alpha}{Ba^{2+}} + \underset{2\alpha}{2Cl^-}$

$\underset{(1-\alpha)}{\phantom{Ba^{2+}}}$

$i = 1 - \alpha + \alpha + 2\alpha = 1 + 2\alpha = 1 + 2(0.95) = 2.9$

The ratio of van't Hoff factors for KCl and $BaCl_2$ = 1.95 : 2.9

8. (d)

9. (b) : Vinyl alcohol ($CH_2=CH-OH$) is less thermodynamically stable with respect to its tautomer acetaldehyde (CH_3CHO). Hence, polyvinyl alcohol is best prepared by the alkaline hydrolysis of polyvinyl acetate which in turn is prepared by the polymerisation of vinyl acetate.

10. (b) : In $Fe_{0.94}O$, some of the Fe^{2+} ions are replaced by Fe^{3+} ions.

Let number of Fe^{2+} ions = x

then number of Fe^{3+} ions = $(0.94 - x)$

Total positive charge must be balanced by total negative charge, $2x + 3(0.94 - x) = 2$

$2x + 2.82 - 3x = 2 \Rightarrow x = 0.82$

So, $Fe^{2+} = 0.82$

$\therefore \quad Fe^{3+} = (0.94 - 0.82) = 0.12$

Ratio of Fe^{2+} (ferrous ions) to Fe^{3+} (ferric ions) :

$\dfrac{Fe^{2+}}{Fe^{3+}} = \dfrac{0.82}{0.12} = \dfrac{41}{6}$ or 41 : 6

11. (a,b,d) : The substances which have lower reduction potentials are strong reducing agents while those which have higher reduction potentials are stronger oxidising agents.

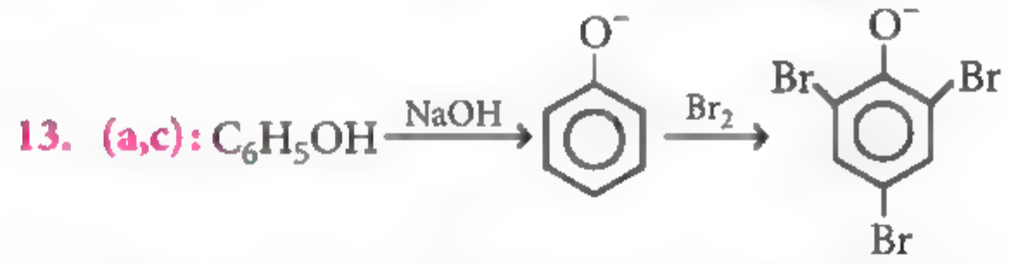
$\because \quad E^{\circ}_{M^{n+}|M}$ for V, Fe and Hg are lower than that of NO_3^-, so NO_3^- will oxidise V, Fe and Hg.

12. (a,b,d) : $\overset{+1}{HClO} \quad \overset{+3}{HClO_2} \quad \overset{+5}{HClO_3} \quad \overset{+7}{HClO_4}$ $\longrightarrow$

With increase in value of n acidic nature increases, thermal stability decreases and oxidising nature decreases.

Cl—O bond order decreases with decreasing value of n.

13. (a,c) :



Due to presence of –ve charge on the oxygen atom of phenoxide ion there is strong activation of benzene ring as a result we get trisubstituted product. (a) and (c) can be intermediates.

14. (a,b,c)

15. (b,c) : Due to resonance,

C—N bond acquires some double bond character, hence shorter in length and shows a planar structure.

CLASS-XII

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2020

Unit II

Polymers | Chemistry in Everyday Life

Polymers

POLYMERS

- The process of formation of a bigger molecule from any simpler molecules through mutual bonding is called polymerisation. The simpler molecules undergoing polymerisation are known as monomers and the bigger molecule formed is called a polymer.

$$n\underset{\text{Ethene (Monomer)}}{CH_2 = CH_2} \xrightarrow{\text{Polymerisation}} \underset{\text{Polythene (Polymer)}}{+CH_2-CH_2+_n}$$

- **Homopolymers :** Polymers made up of only one type of monomers *e.g.*, polythene, polypropylene.

$$n\underset{\text{Propylene}}{CH_3-CH = CH_2} \xrightarrow{\text{Polymerisation}} \underset{\text{Polypropylene}}{+\overset{CH_3}{\overset{|}{CH}}-CH_2+_n}$$

- **Copolymers :** Polymers made up of two or more types of monomers *e.g.*, nylon 6,6. The process of formation of copolymer is called copolymerisation.

$$n\underset{\substack{\text{Hexamethylene-}\\\text{diamine (monomer)}}}{NH_2(CH_2)_6NH_2} + n\underset{\substack{\text{Adipic acid}\\\text{(monomer)}}}{HOOC(CH_2)_4COOH} \xrightarrow[-H_2O]{\text{Polymerisation}} \underset{\substack{\text{Nylon 6, 6}\\\text{(Polymer)}}}{+NH-(CH_2)_6-NH-CO-(CH_2)_4-CO+_n}$$

– Copolymers have better physical and mechanical properties, which can be changed by varying the amount of each monomer.

Classification of Polymers

Types of Polymerisation Reaction

- **Addition polymerisation :** In addition polymerisation, the unsaturated monomeric molecules undergo repeated addition reactions in the presence of catalysts like O_2, organic peroxides. Some examples of addition polymers are polythene from ethylene, polypropylene from propylene, polyisoprene from isoprene. etc.

(i) $n CH_2=\underset{\displaystyle Cl}{\underset{|}{CH}} \longrightarrow +CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}+_n$

Vinyl chloride — Polyvinyl chloride

(ii) $n CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH=CH_2 \rightarrow +CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_2+_n$

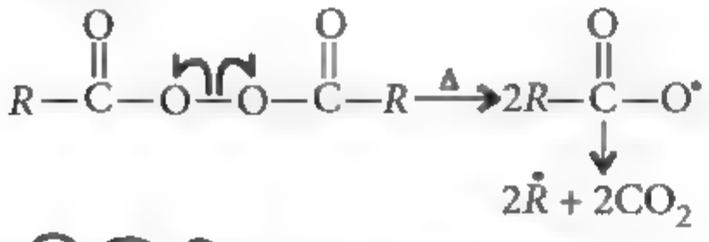
Isoprene — Polyisoprene (Natural rubber)

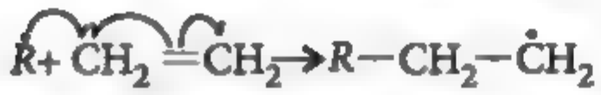
Mechanism of Addition Polymerisation or Chain Growth Polymerisation

- **Free radical addition polymerisation :** This is initiated by adding a substance which generate free radicals called an initiator *e.g.*, benzoyl peroxide.

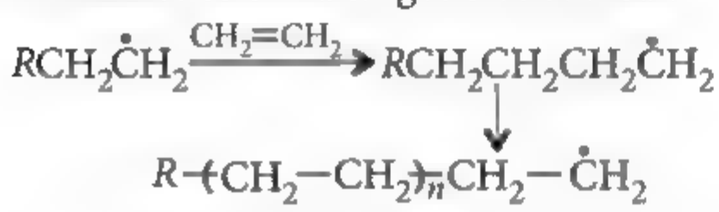
  Chain initiation : Peroxide molecules break up and generate free radicals which act as initiators and react with monomer molecules

and generate a larger free radical or growing chain.



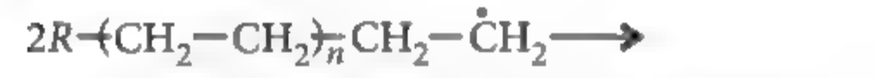


– **Chain propagating step :** The free radical thus formed adds to the double bond of the monomer to form larger free radical.

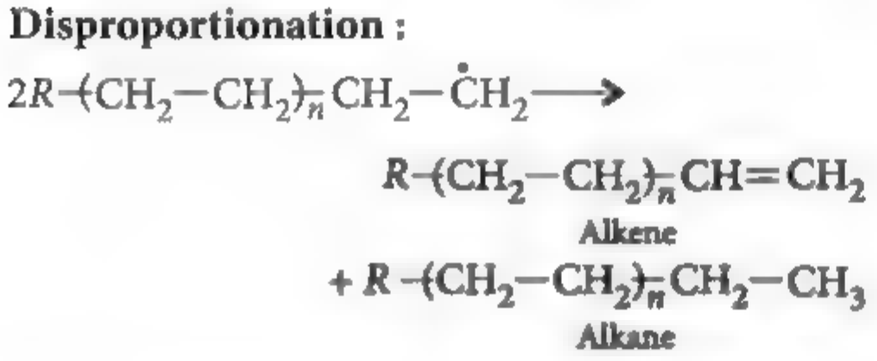


– **Chain terminating step :** The growing free radical chain consumes free radicals either by combination or by disproportionation to get polymer.

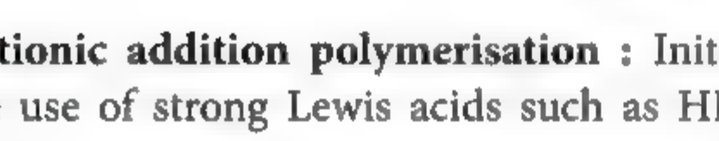
Combination :



Disproportionation :

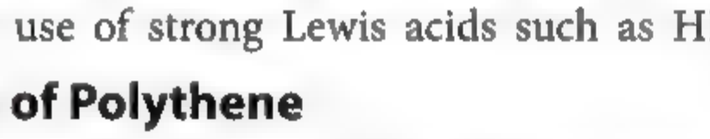


- **Cationic addition polymerisation :** Initiated by the use of strong Lewis acids such as HF, $AlCl_3$, H_2SO_4, etc.



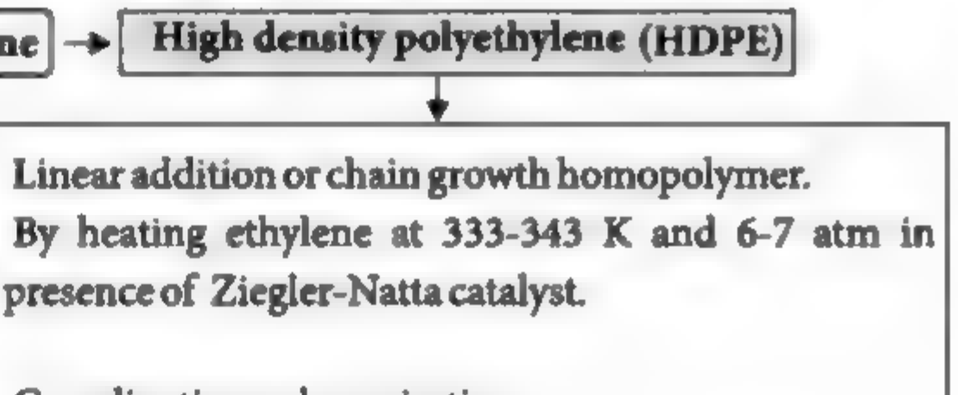
e.g., Polystyrene, polyvinyl ether etc.

- **Anionic addition polymerisation :** Initiated by strong bases such as $NaNH_2$, C_4H_9Li and Grignard reagent, etc.



e.g., Polyacrylonitrile, polyvinyl chloride, etc.

- **Condensation or step growth polymerisation :** Condensation polymerisation normally takes place by condensation of monomeric molecules. For example, terylene is formed by removal of water molecules from ethylene glycol and terephthalic acid molecules.



Some other examples of condensation polymerisation are :

(i) Adipic acid + hexamethylenediamine → Nylon 6, 6 + H_2O

(ii) Phenol + formaldehyde → Bakelite + H_2O

(iii) Urea + formaldehyde → Urea – formaldehyde resin + H_2O

Types of Polythene

Polyethylene

Low density polyethylene (LDPE)

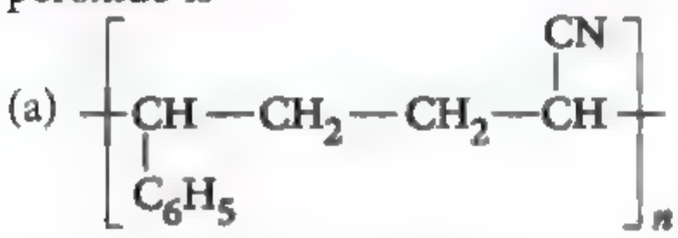
- Addition or chain growth homopolymer.
- By heating ethylene under high pressure (1000-2000 atm) at temperature of 350-570 K in presence of traces of oxygen or peroxide.
- Free radical addition polymerisation.
- Highly branched polymer.
- Low density (0.92 g/cm^3), low melting point (384 K)
- Transparent
- Chemically inert, tough but flexible, moderate tensile strength.
- Used for packaging, insulation and manufacturing squeeze bottles, pipes, toys, etc.

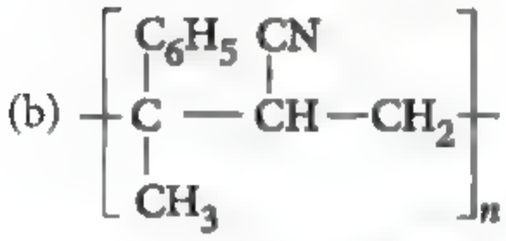
High density polyethylene (HDPE)

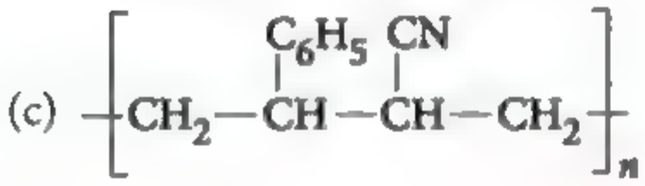
- Linear addition or chain growth homopolymer.
- By heating ethylene at 333-343 K and 6-7 atm in presence of Ziegler-Natta catalyst.
- Coordination polymerisation
- Linear molecules, closely packed.
- High density (0.97 g/cm^3), high melting point (403 K).
- Translucent
- Chemically inert, quite harder, greater tensile strength.
- Used for manufacturing containers, housewares, pipes, etc.

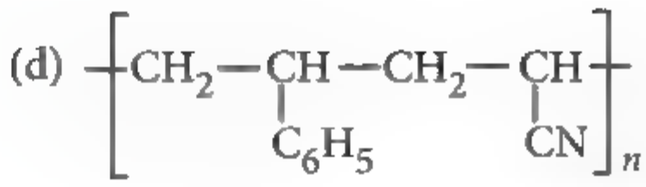
Peep Into Previous Years

1. The copolymer formed by addition polymerization of styrene and acrylonitrile in the presence of peroxide is

(a) 

(b) 

(c) 

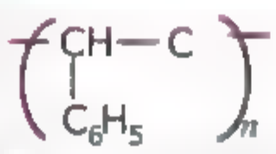
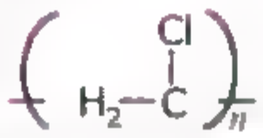
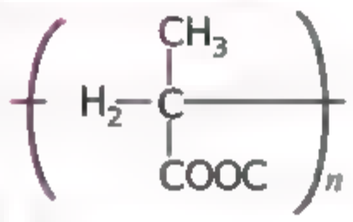
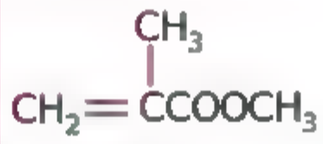
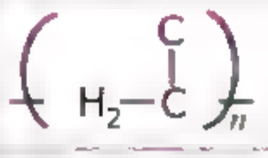
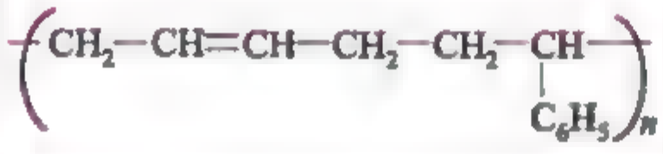
(d) 

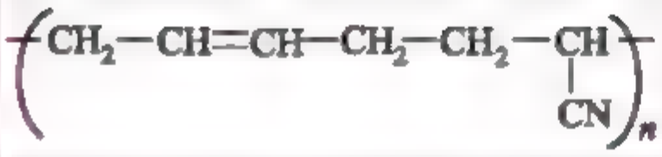
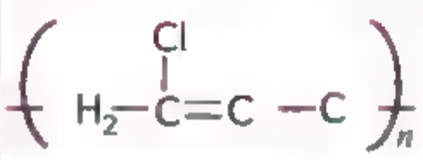
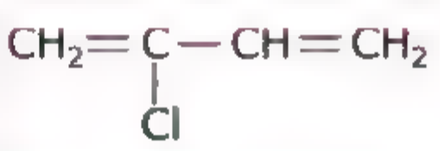
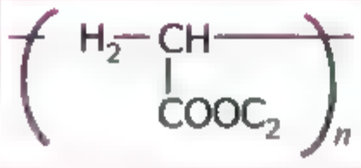
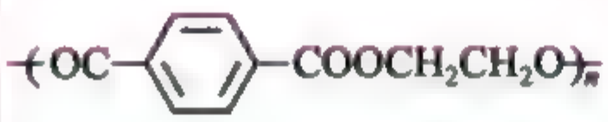
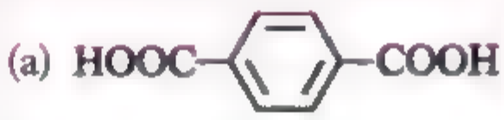
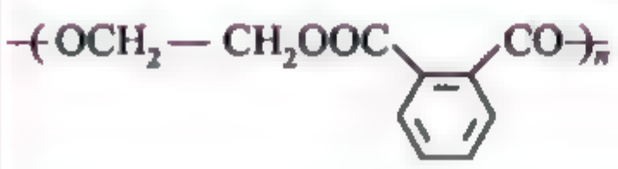
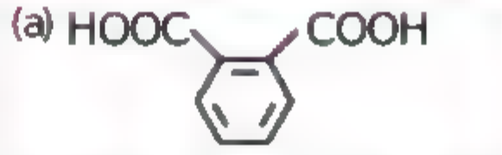
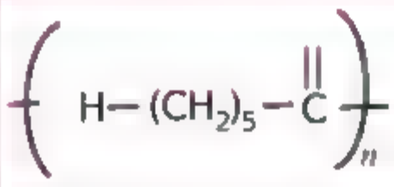
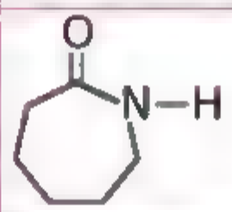
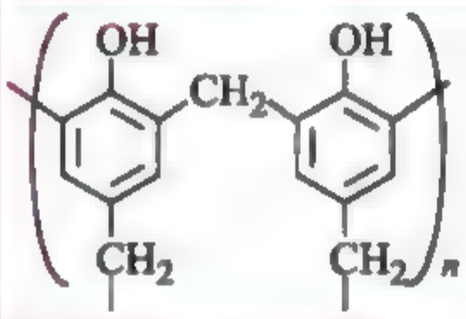
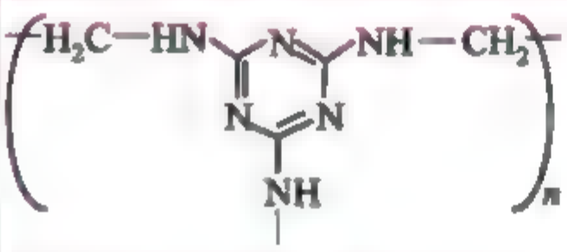
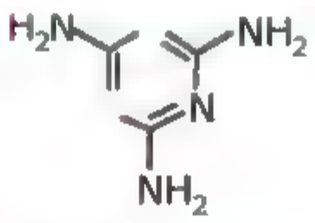
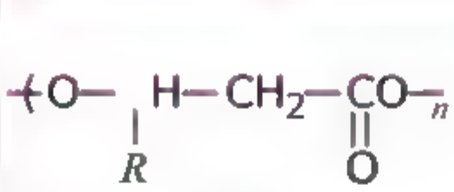
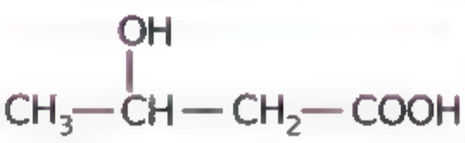
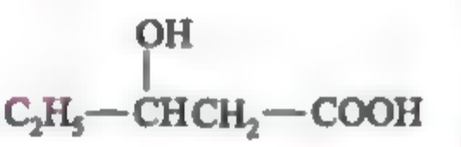
(JEE Main Online 2018)

2. Regarding cross-linked or network polymers, which of the following statements is incorrect?
   (a) They contain covalent bonds between various linear polymer chains.
   (b) They are formed from bi- and tri-functional monomers.
   (c) Examples are bakelite and melamine.
   (d) They contain strong covalent bonds in their polymer chains.

(NEET 2018)

Some Commercially Important Polymers

Name of polymer	Structure	Monomer	Uses
Polyethylene		$CH_2=CH_2$	Used as insulator, anticorrosive, packing material, household and laboratory wares.
Polystyrene		$C_6H_5-CH=CH_2$	Used as insulator, wrapping material, manufacture of toys and household articles.
Polyvinyl chloride		$CH_2=CHCl$	Manufacture of raincoats, hand bags, vinyl flooring and leather clothes.
Polytetrafluoro ethylene (PTFE) or Teflon		$CF_2=CF_2$	As lubricant, insulator and making cooking wares.
Poly methyl methacrylate (PMMA) or Plexiglass			Used as substitute of glass and for making decorative materials.
Polyacrylonitrile (Orlon)		$CH_2=CHCN$	In making synthetic fibres and synthetic wool.
Styrene butadiene rubber (SBR or Buna-S)		(a) $CH_2=CH-CH=CH_2$ (b) $C_6H_5-CH=CH_2$	In making automobile tyres and footwears.

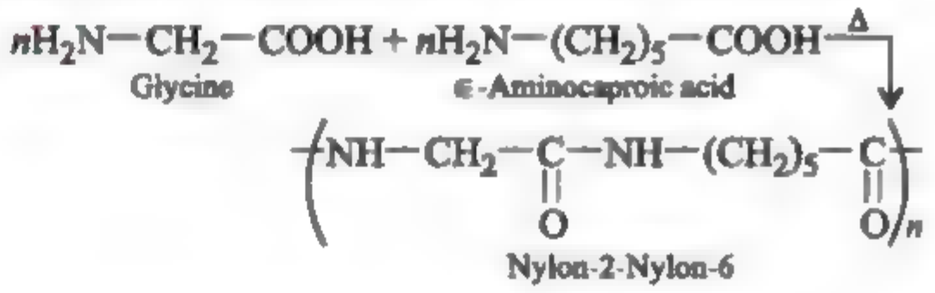
Nitrile rubber (Buna – N)		(a) $CH_2=CH-CH=CH_2$ (b) $H_2C=CH-CN$	In making oil seals, hoses and tank linings.
Neoprene			Used as insulator, in making conveyor belts and printing rollers.
Polyethyl acrylate		$CH_2=CH-COOC_2H_5$	In making films, house pipes and finishing fabrics.
Terylene (Dacron)		(a)  (b) $HO-CH_2-CH_2-OH$	For making films, house pipes and finishing fabrics.
Glyptal		(a)  (b) $HO-CH_2-CH_2-OH$	As binding material in preparation of mixed plastics and paints.
Nylon-6			In making fibres, plastics, tyre cords and ropes.
Nylon-6, 6	$+NH(CH_2)_6NHCO(CH_2)_4CO+_n$	(a) $HOOC-(CH_2)_4-COOH$ (b) $H_2N-(CH_2)_6-NH_2$	In making brushes, synthetic fibres, parachutes, ropes and carpets.
Bakelite		(a) HCHO (b) C_6H_5OH	For making gears, protective coating and electrical fittings.
Urea-formaldehyde resin	$+NH-CO-NH-CH_2+_n$	(a) HCHO (b) NH_2CONH_2	For making unbreakable cups and laminated sheets.
Melamine-formaldehyde resin		(a)  (b) HCHO	In making non-breakable plastic crockery *i.e.*, unbreakable cups and plates.
Poly-β-hydroxy butyrate-co-β-hydroxy valerate (PHBV)	 $R = CH_3-, C_2H_5-$	(a)  (b) 	As packaging, orthopaedic devices and in controlled drug release.

Rubber

- **Natural rubber :**
  - It is obtained as latex from rubber tree.
  - It is highly elastic.
  - It is *cis*-1,4-Polyisoprene.
  - All *trans* configuration occurs as *Gutta-Percha*, which is non-elastic.
- **Synthetic rubber :**
  - It is obtained by polymerizing certain organic compounds which may have properties similar to rubber and some additional desirable properties.
  - Most of these polymers are derived from butadiene derivatives. For example, neoprene, Buna-S, Buna-N, thiokol, polyurethane rubber etc.
  - **Neoprene or polychloroprene :** Prepared by free radical polymerisation in presence of O_2 or peroxides. It has greater stability to aerial oxidation and it is resistant to action of vegetables or mineral oils.
  - **Buna-S :** Prepared by free radical copolymerisation of 1, 3-butadiene and styrene. It is very tough, possesses high abrasion resistance, high load bearing capacity.
  - **Buna-N :** Prepared by copolymerisation of 1, 3-butadiene and acrylonitrile in the presence of a peroxide catalyst.
  - **Thiokol :** Prepared by copolymerisation of ethylenedichloride with sodium tetrasulphide in presence of magnesium hydroxide.
- **Vulcanization of rubber :** It is a process of treating natural rubber with sulphur and an appropriate additive at a temperature range of 373 to 415 K, to modify its properties.
  - On vulcanization sulphur forms cross-links at the reactive sites of the double bonds and gives mechanical strength to the rubber.
  - The extent of hardness or toughness, however, depends upon the amount of sulphur added. Thus, about 5% sulphur is used for making tyre rubber, 20-25% sulphur for making ebonite and 30% sulphur for making battery case rubber.

Biodegradable Polymers

- Biopolymers disintegrate by enzymatic hydrolysis and to some extent by oxidation and hence are biodegradable.
- Synthetic polymers are non-biodegradable and hence create disposal problem. To overcome this, biodegradable synthetic polymers have been developed.
- **Poly-β-hydroxybutyrate-co-β-hydroxyvalerate (PHBV) :** It is a copolymer of 3-hydroxybutanoic acid and 3-hydroxypentanoic acid connected with ester linkages.
  - Used in speciality packaging, orthopaedic devices and in controlled drug release.
- **Dextron :** A copolymer of glycollic acid and lactic acid (90 : 10) was the first biodegradable polyester used for stitching of wounds.
- **Nylon-2-Nylon-6 :** It is a step-growth polyamide copolymer of glycine and ∈-amino caproic acid.



Nylon-2-Nylon-6

Molecular Mass of Polymers

There are two types of average molecular weight in case of polymers :

(a) $\bar{M}_n$ = Number average molecular weight

(b) $\bar{M}_w$ = Weight average molecular weight

(a) Number average molecular weight ($\bar{M}_n$)

$$\bar{M}_n = \frac{\text{Total weight of the molecules}}{\text{Total number of molecules}}$$

$$\bar{M}_n = \frac{n_1M_1 + n_2M_2 + n_3M_3 + ...}{n_1 + n_2 + n_3 + ...}$$

$$\bar{M}_n = \frac{\Sigma n_i M_i}{\Sigma n_i}$$

M_n is generally determined by osmotic pressure method.

(b) Weight average molecular weight ($\bar{M}_w$)

$$\bar{M}_w = \frac{w_1M_1 + w_2M_2 + w_3M_3 + ...}{w_1 + w_2 + w_3 + ...}$$

[weight (w) = no. of moles (n) × molecular weight (M)]

$\bar{M}_w$ is generally determined by the light scattering method.

PDI (Polydispersity Index)

The ratio of the $\bar{M}_w$ and $\bar{M}_n$ is called PDI

$$\text{PDI} = \frac{\bar{M}_w}{\bar{M}_n}$$

In natural polymers, which are generally mono-dispersed, the P.D.I. is unity ($\bar{M}_w = \bar{M}_n$).
In synthetic polymers, which are poly-dispersed, P.D.I. is greater than unity because $\bar{M}_w$ is always higher than $\bar{M}_n$.

Peep Into Previous Years

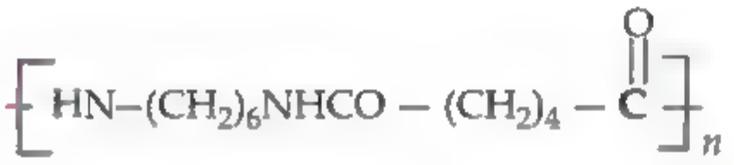
3. The biodegradable polymer is
(a) buna-S (b) nylon-6,6
(c) nylon-2-nylon 6 (d) nylon-6.

(NEET 2019)

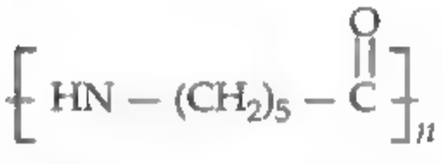
4. Choose the correct option(s) from the following
(a) Teflon is prepared by heating tetrafluoroethene in presence of a persulphate catalyst at high pressure.
(b) Natural rubber is polyisoprene containing *trans* alkene units.
(c) Nylon-6 has amide linkages.
(d) Cellulose has only α-*D*-glucose units that are joined by glycosidic linkages.

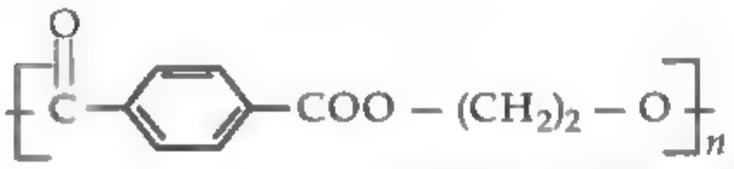
(JEE Advanced 2019)

5. Which of the following is a biodegradable polymer?

(a) 

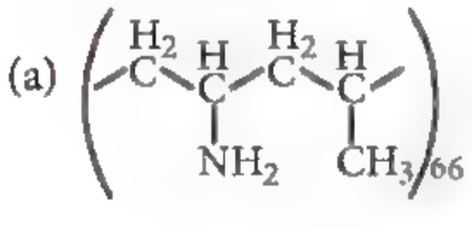
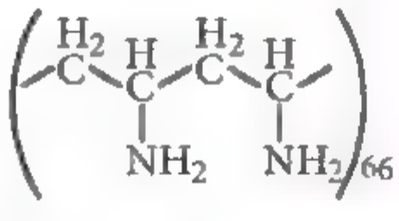
(b) 

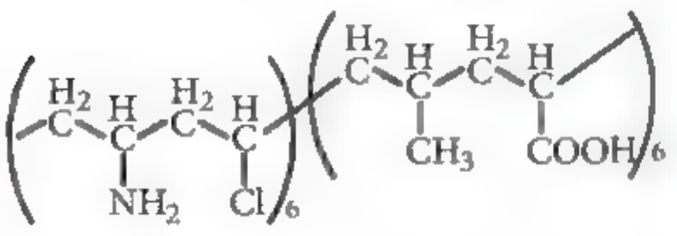
(c) 

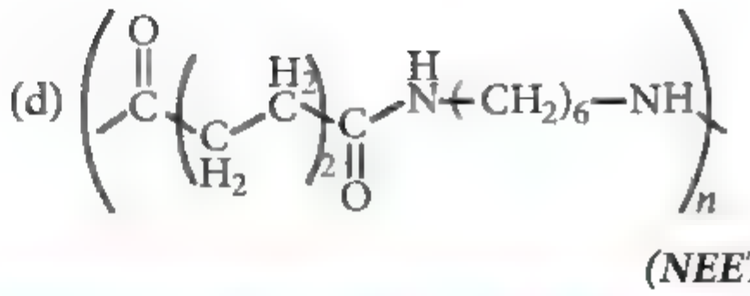
(d) 

(JEE Main Online 2017)

6. Which one of the following structures represents nylon 6, 6 polymer?

(a)  (b) 

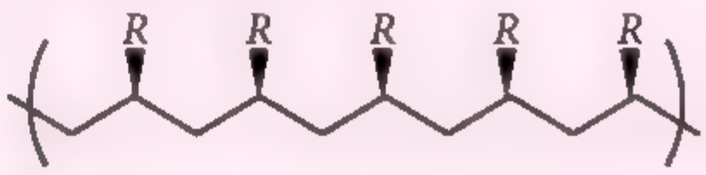
(c) 

(d) 

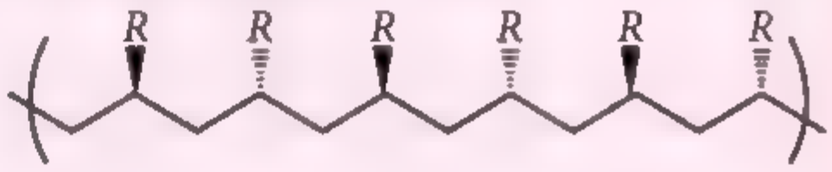
(NEET-II 2016)

Points For Extra Scoring

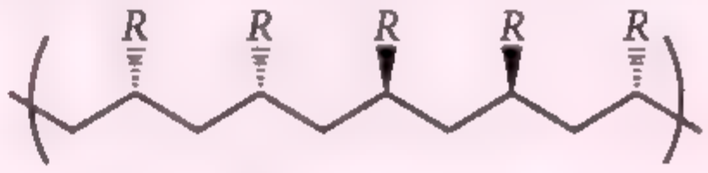
- **Coordination Polymerisation :** It is the process in which the polymerisation occurs through formation of coordination complex.
- **Isotactic** (meaning-same order) : In this type of arrangement all the methyl groups of propylene lie on the same side.



- **Syndiotactic** (meaning-alternating order) : In this case the methyl groups alternate regularly on the opposite side of chain.



- **Atactic** (meaning-no order) : In this type of arrangement no particular order is followed.



- **Polyurethanes.** These are the condensation polymers of toluene-2, 4-diisocyanate and ethylene glycol.
- **Ebonite :** It is a highly vulcanised rubber having about 20–30% of sulphur.
- **Kevlar :** It is a polyamide obtained by condensation copolymerisation and used in making light weight bullet-proof vests.
- **Nomex :** A condensation polyamide used in protective clothing for fire resistance.
- **Lexan :** A condensation copolymerisation polycarbonate (polyester) with unusually high impact strength, used for making bullet proof windows and safety helmets.
- **Rayon (artificial silk) :** It is chemically similar to cotton but shines like silk. Artificial silk is a polysaccharide while natural silk is a protein (polyamide).

Chemistry in Everyday Life

Chemicals in Use

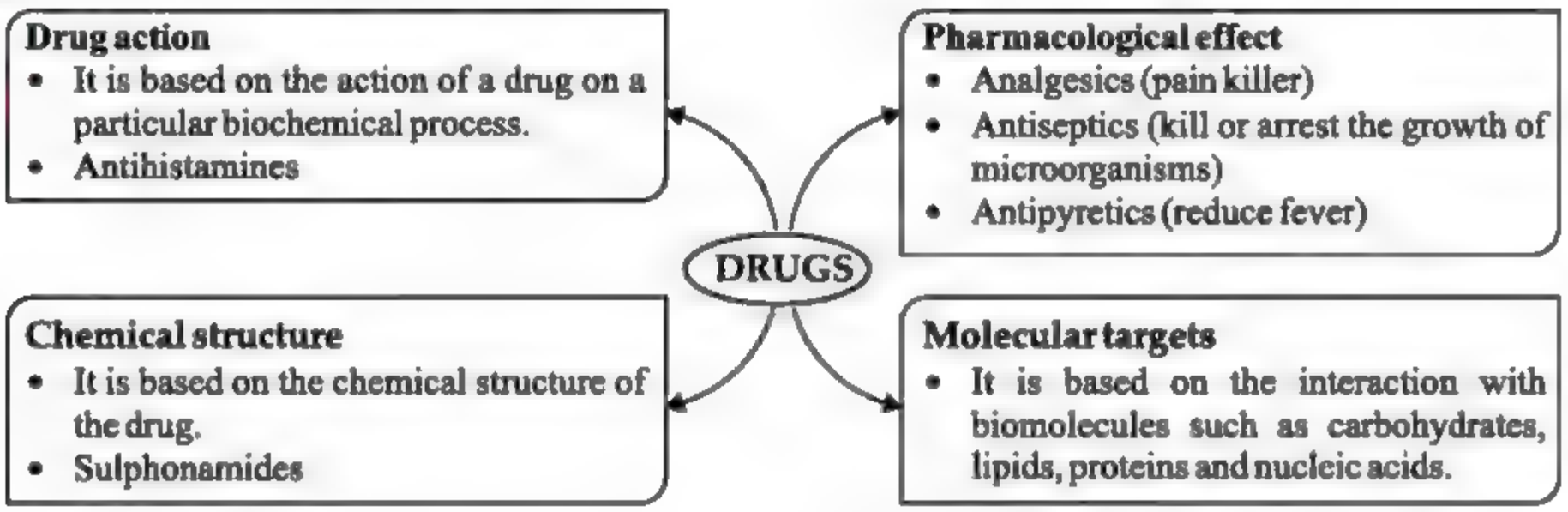
- In various areas, chemicals are used as
  - medicines for the treatment of diseases.
  - food materials
  - cleansing agents like soaps, detergents, household bleaches, tooth pastes, etc.
  - synthetic fibres made up of chemicals only.

Chemicals in Medicines

- Drugs are the chemicals of low molecular masses (~ 100-500 u) which interact with macromolecular targets and produce a therapeutic and useful biological response. These chemicals are called medicines.
- Use of chemicals for therapeutic effect is called chemotherapy.

Classification of Drugs

- Drugs are classified on the basis of



Drug Target Interaction

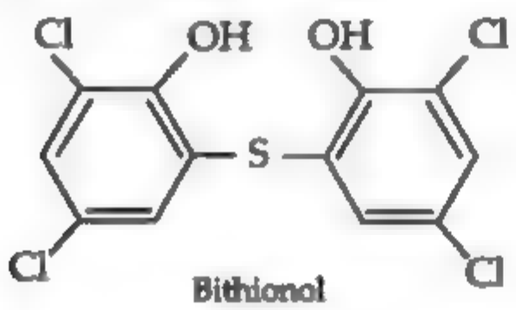
- **Enzymes as drug target :** Drugs inhibit any of the two activities of the enzymes, they can block the binding site of the enzyme and prevent the binding of substrate or they can inhibit the catalytic activity of enzyme.
- **Receptors as drug target :** Proteins which transmit communication to the different parts of the body are called receptors. Receptor proteins are embedded in the cell membrane and receptor changes its shape to accommodate a chemical messenger which brings about transfer of message into the cell.
- **Drug interact with receptors in two ways :**
  - Drugs bind to their receptor sites and inhibit its natural function (antagonists). These are useful when blocking of message is required.
  - Some drugs mimic the natural messenger by switching on the receptor (agonists). These are useful when there is lack of natural chemical messenger.

Therapeutic Action of Different Classes of Drugs

- **Analgesics :** These are chemical substances which reduce pain. They are classified as :
  (i) Non-narcotic analgesics and (ii) Narcotic drugs
  (i) **Non-narcotic analgesics :** Aspirin and paracetamol belong to this class of drugs. They are effective in relieving skeletal pain such as that due to arthritis. They have many other effects such as reducing fever (antipyretic) and preventing platelets coagulation. Aspirin finds use in prevention of heart attacks because of its anti blood clotting action.
  (ii) **Narcotic analgesics :** Morphine and many of its homologues, when administered in medicinal doses, relieve pain and produce sleep. In poisonous doses, they cause convulsions and ultimately death. These are mainly used for the relief of post operative pain, cardiac pains and pains of terminal cancer.
- **Tranquilizers :** These are chemical substances used for the treatment of stress, mild and severe mental

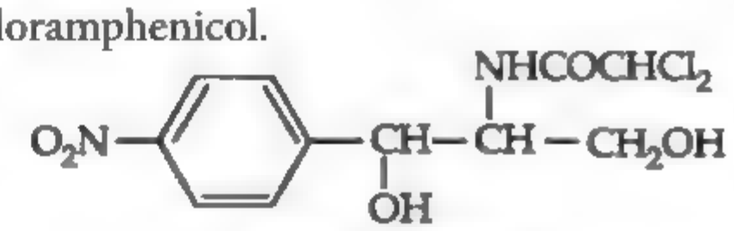
diseases. They are neurologically active drugs and are also called psychotherapeutic drugs, *e.g.*, veronal, amytal, seconal, equanil, chlordiazepoxide, etc.
Veronal, amytal, and seconal are called barbiturates. Barbiturates are hypnotics, *i.e.*, sleep producing agents.

- **Antiseptics :** These are chemicals which either kill or prevent the growth of microorganisms and are applied to the living tissues such as wounds, cuts, ulcers and diseased skin surfaces.
  - Dettol is a commonly used antiseptic and it is a mixture of chloroxylenol and terpineol.
  - Bithionol is added to soaps to reduce odours produced by bacterial decomposition of organic matter on the skin.



Bithionol

  - Tincture of iodine, *i.e.*, 2-3% solution of iodine in alcohol-water mixture is applied on wounds.
- **Disinfectants :** These are also used to kill microorganisms, but they are applied to inanimate objects.
  - Some substances can act both as antiseptic as well as disinfectant by varying the concentration.
  - 0.2% phenol is an antiseptic, whereas its 1% solution is disinfectant.
  - 0.2 - 0.4 ppm chlorine in aqueous solution acts as disinfectant.
- **Antimicrobials :** These are chemical substances used to cure infections due to microorganisms, *e.g.*, sulphadiazine, sulphapyridine, etc.
- **Antifertility drugs :** Chemical substances used to prevent conception or fertilization are called antifertility drugs. These are essentially a mixture of estrogen and progesterone derivatives which are more potent than the natural hormones, *e.g.*, mifepristone, ormeloxifene, etc.
- **Antibiotics :** These drugs are chemical substances produced wholly or partly by chemical synthesis which in low concentration inhibit the growth or destroy microorganisms by intervening in their metabolic processes.
  - The antibiotics may be either bactericidal (kill the organisms in the body) *e.g.*, penicillin, ofloxacin, etc., or bacteriostatic (inhibit the growth of organisms), *e.g.*, erythromycin, chloramphenicol, etc.
  - Antibiotics which kill or inhibit a wide range of Gram-positive and Gram-negative bacteria are said to be broad spectrum antibiotics, *e.g.*, tetracycline, chloromycetin and chloramphenicol.



Chloramphenicol

  - Those effective mainly against Gram-positive or Gram-negative bacteria are narrow spectrum antibiotics, *e.g.*, penicillin-G.
- **Antacids :** These are chemicals which neutralize excess acid in the gastric juices and give relief from acid indigestion, acidity, heart burns and gastric ulcers, *e.g.*, magnesium hydroxide, calcium carbonate, etc.
- **Antihistamines :** These drugs diminish or abolish the main actions of histamine released in the body and hence prevent allergic reactions, they are also called anti-allergic drugs, *e.g.*, diphenylhydramine (benadryl), pheniramine maleate (avil), etc.

Chemicals in Food

- **Preservatives :** These are the chemical substances which are added to the food materials to prevent their spoilage and to retain their nutritive value for long periods. These preservatives prevent the rancidity of food and inhibit the growth or kill the microorganisms.
- The preservation of food by adding sufficient amount of salt to it is called salting. Salt prevents the water from being available for microbial growth.
- The microbial growth in food materials can also be prevented by adding certain chemical substances. The most common preservative used is sodium benzoate (C_6H_5COONa). It is metabolised by conversion to hippuric acid, $C_6H_5CONHCH_2COOH$ which is ultimately excreted through urine.

Quotable Quote

"Once you replace negative thoughts with positive ones, you'll start having positive results."

WILLIE NELSON

- Certain food preservatives such as BHA and BHT are used for edible oils, also act as antioxidants.
- **Artificial sweetening agents :** These are chemical compounds which give sweetening effect to the food and enhance its odour and flavour.

Artificial sweetener	Sweetness value in comparison to cane sugar
Aspartame	180
Sucralose	650
Alitame	2000

- **Antioxidants :** These are the chemical substances which prevent oxidation and subsequent spoilage of the food. These act as sacrificial materials, *i.e.*, they are more reactive towards oxygen than the materials they are protecting. They also reduce the rate of involvement of free radicals in the ageing process.

Peep Into Previous Years

7. Among the following, the narrow spectrum antibiotic is
   (a) chloramphenicol (b) penicillin G
   (c) ampicillin (d) amoxicillin.
   (NEET 2019)

8. The correct match between item-I and item-II is

Item-I	Item-II
A. Allosteric	P. Molecule binding effect to the active site of enzyme
B. Competitive	Q. Molecule crucial for inhibitor communication in the body
C. Receptor	R. Molecule binding to a site other than the active site of enzyme
D. Poison	S. Molecule binding to the enzyme covalently

   (a) A → P, B → R, C → Q, D → S
   (b) A → R, B → P, C → Q, D → S
   (c) A → P, B → R, C → S, D → Q
   (d) A → R, B → P, C → S, D → Q
   (JEE Main 2019)

9. The reason for "drug induced poisoning" is
   (a) binding reversibly at the active site of the enzyme
   (b) bringing conformational changes in the binding site of enzyme
   (c) binding at the allosteric sites of the enzyme
   (d) binding irreversibly to the active site of the enzyme.
   (JEE Main Online 2017)

10. Which of the following is an analgesic?
   (a) Streptomycin (b) Chloromycetin
   (c) Novalgin (d) Penicillin
   (NEET-I 2016)

Cleansing Agents

- Soaps are sodium or potassium salts of long chain fatty acids, *e.g.*, stearic, oleic and palmitic acids. Soaps containing sodium salts are prepared by heating glyceryl ester of fatty acid with aqueous NaOH solution and the reaction is known as saponification.
- Only Na/K soaps are soluble in water and are used for cleaning purposes. Generally, potassium soaps are soft to the skin than sodium soaps.
- **Types of soaps**
  - Toilet soaps are prepared by using better grades of fats and oils and care is taken to remove excess alkali. Colour and perfumes are added to make them more attractive.
  - Soaps that float in water are made by beating tiny air bubbles before their hardening. Transparent soaps are made by dissolving the soap in ethanol and then evaporating the excess solvent.
  - In medicated soaps, substances of medicinal value are added. In some soaps, deodorants are added. Shaving soaps contain glycerol to prevent rapid drying. A gum called, rosin is added while making them. It forms sodium rosinate which lathers well. Laundry soaps contain fillers like sodium rosinate, sodium silicate, borax and sodium carbonate.
  - Soap chips are made by running a thin sheet of melted soap onto a cool cylinder and scraping off the soaps in small broken pieces. Soap granules are dried miniature soap bubbles. Soap powders and scouring soaps contain some soap, a scouring agent (abrasive) such as powdered pumice or finely divided sand, and builders like sodium carbonate and trisodium phosphate.

CONCEPT MAP

SURE SHOT TOPICS OF ORGANIC CHEMISTRY

(ORGANIC COMPOUNDS CONTAINING HALOGENS, OXYGEN AND NITROGEN)

SURE SHOT TOPICS OF ORGANIC CHEMISTRY
(ORGANIC COMPOUNDS CONTAINING HALOGENS, OXYGEN AND NITROGEN)

Haloalkanes and Haloarenes

Haloalkanes

Nucleophilic Substitution Reactions

S_N1 reaction

- It is first order reaction
- Generally carried out in polar protic solvents like water, alcohol and acetic acid
- Takes place in two steps through carbocation as the intermediate
- Rate of reaction : $3° > 2° > 1°$ Methyl halides
- Tends to proceed with weak nucleophiles, e.g., CH_3OH, H_2O CH_3CH_2OH etc.
- Both retention and inversion of configuration takes place, racemic mixture is obtained.

S_N2 reaction

- It is second order reaction
- Carried out in polar aprotic solvents like acetone, DMSO, acetonitrile or DMF
- Takes place in one step through transition state
- Rate of reaction : $CH_3X > 1° > 2° > 3°$ halides
- Lesser the steric hindrance in transition state, faster will be the reaction
- Tends to proceed with strong nucleophiles, e.g., CH_3O^-, CN^-, OH^- etc.
- Inversion of configuration takes place (Walden inversion).

Chemical Properties

- **Dehydrohalogenation :** $-\underset{H}{\overset{|}{C}}-\underset{X}{\overset{|}{C}}- \xrightarrow{\text{Base}} -C=C-$

  $H_3C-\underset{CH_3}{\overset{|}{CH}}-Cl + KOH_{(alc.)} \longrightarrow H_3C-CH=CH_2$

- **Friedel–Crafts reaction :**

- **Wurtz reaction**

  $R-\boxed{X + 2Na + X}-R \xrightarrow{\text{Ether}} R-R + 2NaX$

Elimination reactions

E1 : In 2 steps. Reactivity of alkyl halides $3° > 2° > 1°$

E2 : In 1 step Via transition state Favourable $\rightarrow$ $1°$ alkyl halide

Haloarenes

- The aryl halides are relatively less reactive towards nucleophilic substitution reactions as compared to alkyl halides. This low reactivity can be attributed due to the following factors
  The C—X bond in halobenzene has a partial double bond character due to involvement of halogen electrons in resonance with benzene ring.
- The C—X bond in aryl halides is less polar as compared to that in alkyl halides as sp^2 hybridised carbon is more electronegative than sp^3 hybridised carbon

Alcohols, Phenols and Ethers

Alcohols

Preparation

- **By acid catalysed hydration :**

  $CH_3CH=CH_2 + H_2O \underset{}{\overset{H^+}{\rightleftharpoons}} CH_3-CH(OH)-CH_3$

- **By reduction of aldehydes and ketones :**

  $RCHO + H_2 \xrightarrow{Pd} R-CH_2OH$, $RCOR' \xrightarrow{NaBH_4} R-CH(OH)-R'$

- **From Grignard reagents :** $RCHO + RMgX \xrightarrow{H_2O^+} R-\underset{R}{\overset{R'}{\underset{|}{\overset{|}{C}}}}-OMgX \xrightarrow{H_2O} R-\underset{R}{\overset{R'}{\underset{|}{\overset{|}{C}}}}-OH + Mg(OH)X$

Chemical Properties

- **Dehydration :** $C_2H_5OH \xrightarrow[413\,K]{H_2SO_4} CH_2=CH_2 + H_2O$

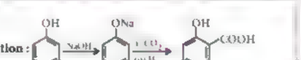
  Acid catalysed dehydration of alcohols follows carbocation mechanism. Thus, relative ease of dehydration of alcohols follows the following order $3° > 2° > 1°$

- **Oxidation** $RCH_2OH \xrightarrow{[O]} R-\underset{\text{Aldehyde}}{\overset{H}{\underset{|}{\overset{|}{C}}}}=O \xrightarrow{[O]} R-\underset{\text{Carboxylic acid}}{\overset{OH}{\underset{|}{\overset{|}{C}}}}=O$

Phenols

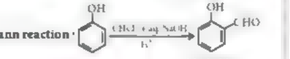
Preparation

- **Kolbe's reaction :**

  2 Hydroxybenzoic acid
  Salicylic acid

- **Reimer-Tiemann reaction :**

  Salicylaldehyde

Ethers

Preparation

- **From alcohols by dehydration :** $2ROH \xrightarrow[413\,K]{H_2SO_4} ROR$
- **From alkyl halide :** $R-X + RONa \xrightarrow[-NaX]{\Delta} ROR$ (Williamson synthesis)

Chemical Properties

- **Friedel-Crafts reaction :**

  2 Methoxytoluene (Minor)
  4 Methoxytoluene (Major)

Aldehydes, Ketones and Carboxylic acids

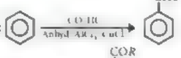
Aldehydes and Ketones

Preparation

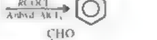
- **Oxidation of alcohols :**

  $RCH_2OH + [O] \xrightarrow[H_2SO_4\,(dil.)]{K_2Cr_2O_7} RCHO + H_2O$

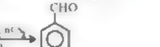
- **Gatterman-Koch reaction :**

- **Friedel-Crafts acylation :**

- **Etard reaction :**

- **Rosenmund reduction :** $RCOCl + H_2 \xrightarrow[\text{boiling xylene}]{Pd\,BaSO_4,\,S} RCHO + HCl$

Chemical Properties

- **Nucleophilic addition reactions :** Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and electronic reasons.
- **Haloform reaction :** Given by compounds having CH_3CO- group or $CH_3CH(OH)-$ group.

  $RCOCH_3 \xrightarrow{NaOX} RCOONa + CHX_3$
  Haloform

- **Aldol condensation :**
  Aldehydes and ketones having at least one α-H atom undergo a reaction in the presence of dilute alkali as catalyst to form β-hydroxy aldehydes (aldols) or β-hydroxy ketones (ketols), respectively.
  The aldol and ketol readily lose water to give α, β-unsaturated carbonyl compounds.
- **Cannizzaro reaction :** Aldehydes which do not have α-H atom undergo disproportionation on heating with concentrated alkali.

Carboxylic Acids

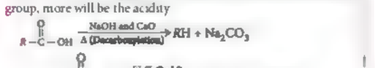
Chemical Properties

- Hydroxyl group of acids is more acidic than the hydroxyl group of alcohols and phenols.
- **Acidity order :** Carboxylic acids > Phenols > Alcohols
- More is the electronegativity of the atom attached to the carboxyl group, more will be the acidity

$R-\underset{}{\overset{O}{\underset{|}{\overset{||}{C}}}}-OH \xrightarrow[\Delta\,(\text{Decarboxylation})]{NaOH\text{ and }CaO} RH + Na_2CO_3$

$R-CH_2-\underset{}{\overset{O}{\underset{|}{\overset{||}{C}}}}-OH \xrightarrow[(ii)\,H_2O]{(i)\,X_2/Red\,P} R-\underset{X}{\overset{|}{CH}}-COOH$
α-Halocarboxylic acid
(Hell-Volhard-Zelinsky reaction)

$R-CH_2-\underset{}{\overset{O}{\underset{|}{\overset{||}{C}}}}-OH + 6HI \xrightarrow[473\,K]{Red\,P} RCH_2CH_3 + 2H_2O + 3I_2$



Amines

Aliphatic Amines

Chemical Properties

- **Basic character of amines**
  Amines are basic in nature due to the presence of lone pair of electrons on nitrogen atom.
  Aliphatic amines are stronger bases than ammonia due to $+I$ effect of alkyl groups present in amines.
  Aromatic amines are weaker bases than ammonia due to $-I$ effect of aryl group.
  Beside inductive effect, there are other effects like steric effect, solvation effect, resonance effect which affect the basic strength of amines.
  In gaseous phase, the order of basicity of amines is $3°$ amine > $2°$ amine > $1°$ amine > NH_3.
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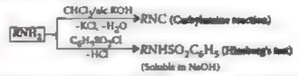
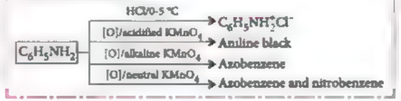


Aniline

Chemical Reactions

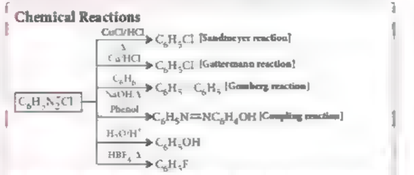


Diazonium Salts

Preparation

$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{0-5°C} C_6H_5N_2^+Cl^- + NaCl + 2H_2O$

Chemical Reactions



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  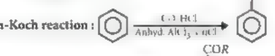

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  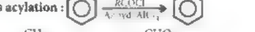

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  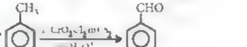

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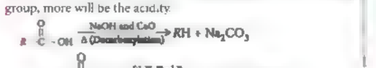

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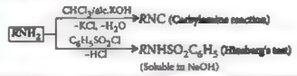
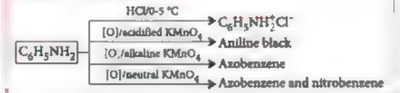
Chemical Reactions



Aniline

Chemical Reactions



Diazonium Salts

Preparation

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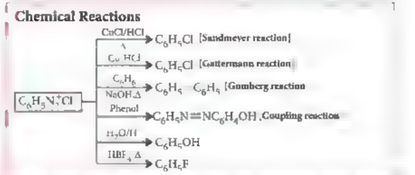
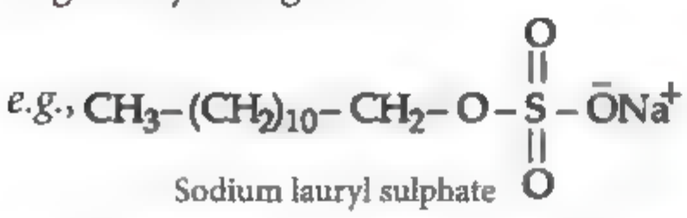
Chemical Reactions



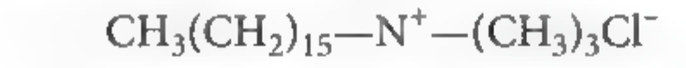
- **Detergents :** These are the materials which are used for cleaning purposes. They are also called soapless soaps.
  - **Anionic detergents :** Their polar head is negatively charged.



e.g., $CH_3-(CH_2)_{10}-CH_2-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-\bar{O}Na^+$

Sodium lauryl sulphate

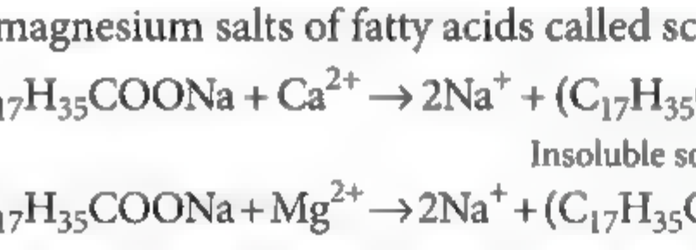
Such detergents are used to wash clothes.
  - **Cationic detergents :** Their polar head is positively charged *e.g.*,



$CH_3(CH_2)_{15}—N^+—(CH_3)_3Cl^-$

Trimethylhexadecylammonium chloride

These are used as fabric softener and hair conditioner.
  - **Non-ionic detergents :** Their polar head is neutral *e.g.*, Polyethyleneglycol stearate, $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$
Such detergents are used in dish washers.
- **Action of soap in hard water :** Hard water contains Ca^{2+} or Mg^{2+} ions which react with sodium or potassium salts of fatty acids (soap) to form calcium or magnesium salts of fatty acids called scum.



$2C_{17}H_{35}COONa + Ca^{2+} \rightarrow 2Na^+ + (C_{17}H_{35}COO)_2Ca$

Insoluble soap or scum

$2C_{17}H_{35}COONa + Mg^{2+} \rightarrow 2Na^+ + (C_{17}H_{35}COO)_2Mg$

- **Advantages of synthetic detergents over soaps :**
  - They can be used in hard water, in acidic medium while soaps get precipitated.
  - They are more soluble in water and thus form lather more easily.
  - They are stronger cleansing agents than soaps as they decrease the surface tension to greater extent.

Peep Into Previous Years

11. The liquified gas that is used in dry cleaning along with a suitable detergent is
(a) water gas (b) petroleum gas
(c) NO_2 (d) CO_2.
(Odisha NEET 2019)

12. Which of the following is an anionic detergent?
(a) Sodium stearate
(b) Sodium lauryl sulphate
(c) Cetyltrimethylammonium bromide
(d) Glyceryl oleate *(JEE Main 2016)*

Points For Extra Scoring

- Ibuprofen is a chiral drug. Only its (*S*)-isomer is effective but (*R*)-isomer has no anti-inflammatory action. However, the (*R*)-isomer is slowly converted into the (*S*)-isomer in the body but the (*S*)-isomer alone acts much more quickly than the racemate.
- **Uses of sulpha drugs :**

Sulphapyridine	: used to cure pneumonia.
Sulphadiazine	: used to cure pneumonia, throat infection, meningitis, etc.
Sulphaguanidine	: used to cure bacillary dysentery.
Sulphathiazole	: useful against staphylococcal infections and bubonic plague.
Succinyl sulphathiazole	: useful in intestinal infections such as bacillary dysentery and cholera.
Sulpha acetamide	: used to cure urinary tract infections.

- Ranitidine and cimetidine are used in the treatment of peptic ulcers.
- Pentaprazole and omeprazole are the new drugs used to inhibit gastric secretion.
- In addition to sugar and salt the substances such as vinegar, oils, spices and citric acid are also used to preserve jam, pickles, ketchups and squashes, etc.
- Highly branched sodium alkylbenzene-sulphonates are non-biodegradable.

Answer Key For Peep Into Previous Years

1.	(d)	2.	(d)	3.	(c)	4.	(a, c)	5.	(b)	6.	(d)
7.	(b)	8.	(b)	9.	(c)	10.	(c)	11.	(d)	12.	(b)

WRAP it up!

1. Which of the following polymers do not involve cross linkages?
   (a) polystyrene (b) polyurethane
   (c) polyurea (d) polyamide.

2. Which one of the following is an antimalarial drug?
   (a) Phenol (b) DDT
   (c) Paludrine (d) DDE

3. The catalyst used for olefin polymerisation is
   (a) Ziegler-Natta catalyst
   (b) Wilkinson catalyst
   (c) Raney nickel catalyst
   (d) Merrifield resin.

4. Match Column I (Monomer) with column II (Polymer) and select the correct option.

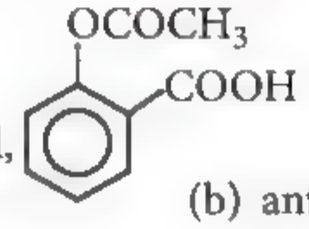
Column I		Column II	
I.	Hexamethylenediamine + Adipic acid	A.	Bakelite
II.	Phenol + Formaldehyde	B.	Dacron
III.	Phthalic acid + Ethylene glycol	C.	Glyptal
IV.	Terephthalic acid + Ethylene glycol	D.	Nylon 6, 6

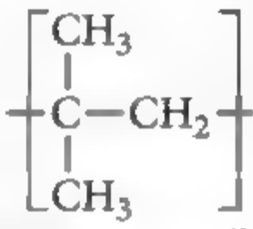
   (a) I-D, II-A, III-B, IV-C
   (b) I-D, II-A, III-C, IV-B
   (c) I-D, II-C, III-A, IV-B
   (d) I-D, II-B, III-A, IV-C

5. Which of the following is an incorrect statement?
   (a) Non-ionic detergents are neutral.
   (b) The hydrophilic portion of a non-ionic detergent functions by a hydrogen bonding mechanism.
   (c) Cationic detergents have a positively charged water soluble portion.
   (d) LABs detergent are non-biodegradable.

6. The monomers of Buna-S rubber are
   (a) styrene and 1, 3-butadiene
   (b) isoprene and 1, 3-butadiene
   (c) vinyl chloride and sulphur
   (d) butadiene and acrylonitrile.

7. Soft drinks and baby feeding bottles are generally made up of
   (a) Melmac (b) Bakelite
   (c) Teflon (d) Vulcanised rubber

8. The compound,  is used as a
   (a) antiseptic (b) antibiotic
   (c) analgesic (d) pesticide.

9. Monomer of  is
   (a) 2-methylpropene (b) styrene
   (c) propylene (d) ethene.

10. Which of the following statements is not correct?
   (a) Soaps act by lowering surface tension between water and oil/insoluble material.
   (b) The soap form insoluble salt with Ca^{2+} ions.
   (c) The COO^- group in soaps acts as hydrophilic and alkyl chain as hydrophobic.
   (d) Soaps work more efficiently in hard water than in soft water.

11. The turbidity of a polymer solution measures
   (a) the light scattered by solution
   (b) the light absorbed by a solution
   (c) the light transmitted by a solution
   (d) none of these.

12. Nylon is classified as a condensation polymer because
   (a) in its preparation a solid is formed from liquid monomers
   (b) its structure contains the peptide linkage (—CONH—).
   (c) it can be prepared from aqueous solutions of its monomers.

Monthly Test Drive CLASS XII **ANSWER KEY**

1. (a)	2. (a)	3. (a)	4. (c)	5. (d)
6. (b)	7. (a)	8. (d)	9. (c)	10. (c)
11. (c)	12. (d)	13. (c)	14. (a)	15. (a)
16. (b)	17. (b)	18. (b)	19. (d)	20. (a,b,c)
21. (b,c,d)	22. (a,b,d)	23. (a,c,d)	24. (2)	25. (5)
26. (5)	27. (d)	28. (a)	29. (a)	30. (c)

(d) a small molecule is eliminated in its formation from its monomers.

13. A broad spectrum antibiotic is
(a) paracetamol (b) penicillin-G
(c) aspirin (d) chloramphenicol.

14. The drug given during hypertension is
(a) streptomycin (b) chloroxylenol
(c) equanil (d) aspirin.

15. The condensation polymer among the following is
(a) protein (b) PVC
(c) polythene (d) rubber.

16. Which one of the following is not an example of chain growth polymer?
(a) Neoprene (b) Buna-S
(c) PMMA (d) Glyptal

17. Which of the following statements is true for detergents?
(a) ABS is a anionic detergent.
(b) Cetyltrimethylammonium bromide is a cationic detergent.
(c) Polyethylene glycol stearate is a non-ionic detergent.
(d) All of these.

18. The structural formula of monomer of poly methylmethacrylate (PMMA) is

(a) $CH_2=CHCOOCH_3$ (b) $CH_2=C(CH_3)-COOCH_3$
(c) $CH_3COOCH=CH_2$ (d) $CH_3COOC(CH_3)=CH_2$

19. The amount of alkali necessary to convert an oil or fat into soap is known by its
(a) iodine value (b) Reichert Meissl value
(c) saponification value (d) acid value.

20. Di-(*n*-butyl) phthalate is a
(a) plasticizer (b) thermoplastic
(c) polymer (d) thermosetting plastic.

SOLUTIONS

1. (c) : $nF_2C=CF_2 \xrightarrow[\text{High pressure}]{(NH_4)_2S_2O_8} (-F_2C-CF_2-)_n$
Tetrafluoroethene → Teflon

2. (c) : Paludrine tablets contain the active ingredient proguanil hydrochloride, which is an antimalarial medicine.

3. (a) : Ziegler-Natta catalyst $[(C_2H_5)_3Al + TiCl_4]$ is used in linear polymerisation to prepare high density polyethylene (HDPE).

4. (b) **5. (d)**

6. (a) : Buna - S is also known as Styrene-Butadiene Rubber (SBR).

$$n\,CH_2=CH-CH=CH_2 + n\,C_6H_5-CH=CH_2 \longrightarrow$$

1,3 Butadiene — Styrene

$$\left[CH_2-CH=CH-CH_2-CH_2-CH(C_6H_5)\right]_n$$

Buna-S

7. (a)

8. (c) : Aspirin or acetylsalicyclic acid or 2-acetoxybenzoic acid is an analgesic as well as antipyretic.

9. (a) : Formula of the monomer indicated in bracket, $(CH_3)_2C=CH_2$, corresponds to 2-methylpropene.

10. (d) : The incorrect statement is, "soaps work more efficiently in hard water than in soft water. Soaps actually do not give foams in hard water due to formation of insoluble salts like calcium stearate and magnesium stearate. As hard water contain carbonates and bicarbonates of Ca and Mg.

11. (a) : When light passes through a polymer solution it scatters and turbidity of a polymer solution measures light scattered by the solution.

12. (d) : Nylon is a condensation polymer because in the reaction of adipic acid with hexamethylenediamine, small molecule like H_2O is eliminated in its formation.

13. (d)

14. (c) : Equanil is used in controlling depression and hypertension.

15. (a) : Condensation polymers are formed by the combination of monomers with the elimination of simple molecules like water or alcohol, *e.g.*, polyesters and polyamides. Thus, out of the given options, proteins are condensation polymers of amino acids.

16. (d) : Glyptal is an example of a step growth polymer.

17. (d) : All statements are true.

18. (b) : The monomer of PMMA is methyl methacrylate *i.e.*, $CH_2=C(CH_3)-COOCH_3$.

19. (c)

20. (a) : Di-(*n*-butyl) phthalate is a plasticizer, added to PVC to make it soft.

Exam on 7th March 2020

CLASS-XII

CBSE warm-up!

Practice questions for CBSE Exams as per the latest pattern and marking scheme issued by CBSE for the academic session 2019-20.

Practice Paper 2020

Time Allowed : 3 hours
Maximum Marks : 70

GENERAL INSTRUCTIONS

(i) All questions are compulsory.
(ii) Section A: Q.no. 1 to 20 are very short answer questions (objective type) and carry 1 mark each.
(iii) Section B: Q.no. 21 to 27 are short answer questions and carry 2 marks each.
(iv) Section C: Q.no. 28 to 34 are long answer questions and carry 3 marks each.
(v) Section D: Q.no. 35 to 37 are also long answer questions and carry 5 marks each.
(vi) There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
(vii) Use log tables if necessary, use of calculators is not allowed.

SECTION - A

Read the given passage and answer the questions 1 to 5 that follow :

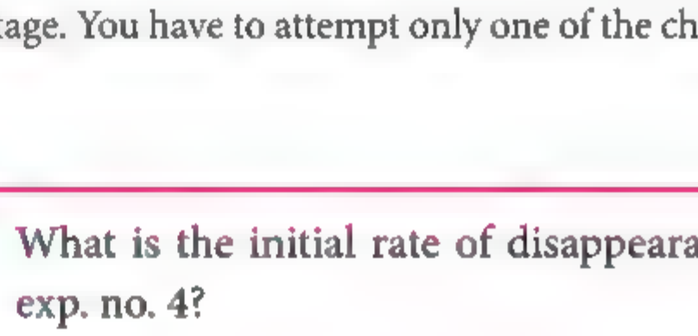
For the reaction, $2NO_{(g)} + Cl_{2(g)} \longrightarrow 2NOCl_{(g)}$ the following data were collected. All the measurements were taken at 263 K.

Exp. No.	Initial [NO](M)	Initial $[Cl_2]$ (M)	Initial rate of disapp. of Cl_2 (M/min)
1.	0.15	0.15	0.60
2.	0.15	0.30	1.20
3.	0.30	0.15	2.40
4.	0.25	0.25	?

1. Write the expression for rate law?
2. What is the order of the reaction?
3. What is the molecularity of the reaction?
4. Calculate the value of rate constant and specify its units.
5. What is the initial rate of disappearance of Cl_2 in exp. no. 4?

Questions 6 to 10 are one word answers :

6. Name a drug used in case of mental depression.
7. Give the IUPAC name of $[Co(H_2NCH_2CH_2NH_2)_3]_2(SO_4)_3$.
8. Name the method used for the refining of titanium metal.
9. Give the name of product of the following reaction :



10. Name the polymer used in making non-stick kitchenwares.

Questions 11 to 15 are multiple choice questions :

11. During the extraction of gold the following reactions take place :

$Au + CN^- + H_2O \xrightarrow{O_2} [X]$

$[X] + Zn \longrightarrow [Y] + Au$

X and Y are respectively

(a) $[Au(CN)_2]^-$ and $[Zn(CN)_6]^{4-}$

(b) $[Au(CN)_4]^{2-}$ and $[Zn(CN)_4]^{2-}$

(c) $[Au(CN)_4]^{3-}$ and $[Zn(CN)_4]^{2-}$

(d) $[Au(CN)_2]^-$ and $[Zn(CN)_4]^{2-}$

12. A greenish yellow gas (X) reacts with hot and conc. alkali metal hydroxide to form a halate (Y) which can be used in fireworks and safety matches. The gas (X) and the halate (Y) are

(a) Br_2 and $KBrO_3$ (b) Cl_2 and $KClO_3$

(c) I_2 and $NaIO_3$ (d) I_2 and KIO_3

13. Some drugs interact with enzymes and make them biologically inactive. Such drugs are called

(a) enzyme promoters (b) enzyme inhibitors

(c) allogens (d) all of these.

14. Which one of the following monomers form biodegradable polymer?

(a) Urea and formaldehyde

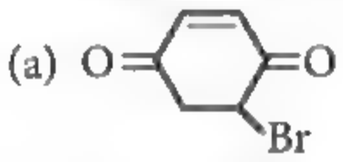
(b) Ethylene glycol and terephthalic acid

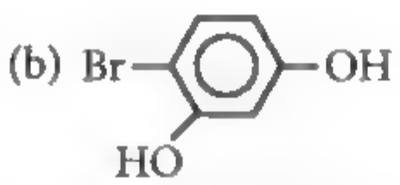
(c) 3-Hydroxybutanoic acid and 3-hydroxypentanoic acid

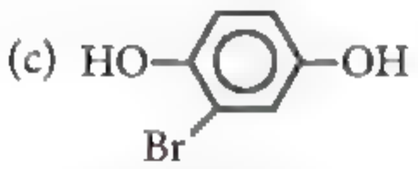
(d) Phenol and caproic acid

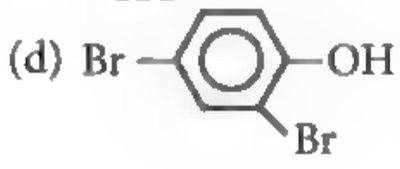
15. In the given reaction,

(A) would be

(a) 

(b) 

(c) 

(d) 

Questions 16 to 20 :

(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.

(b) Both assertion and reason are correct statements but reason is not the correct explanation of the assertion.

(c) Assertion is correct, but reason is wrong statement.

(d) Assertion is wrong, but reason is correct statement.

16. **Assertion :** Sodium 4-(2-dodecyl) benzene sulphonate is a biodegradable detergent.
Reason : Detergents having highly branched chains are biodegradable.

17. **Assertion :** Electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene.
Reason : Halogens are *ortho* and *para*-directors.

18. **Assertion :** Aromatic aldehydes and formaldehydes undergo Cannizzaro reaction.
Reason : Those aldehydes which have α-H atom undergo Cannizzaro reaction.

19. **Assertion :** Froth floatation process is based on the different wetting nature of ore and gangue particles.
Reason : Mustard oil is used as frother in froth floatation process.

20. **Assertion :** *Ortho* and *para*-nitrophenol can be separated by steam distillation.
Reason : *Para*-nitrophenol is steam volatile due to intramolecular hydrogen bonding.

SECTION - B

21. (i) Arrange the following in the increasing reactivity for S_N1 reactions :
$C_6H_5CH_2Br$, $C_6H_5CH(C_6H_5)Br$, $C_6H_5CH(CH_3)Br$, $C_6H_5C(CH_3)(C_6H_5)Br$

(ii) Alkyl halides, though polar, are immiscible with water, why ?

22. Explain the following :

(i) Low spin octahedral complexes of nickel are not known.

(ii) $\Delta_t = \frac{4}{9}\Delta_o$

OR

Using valence bond theory of complexes, explain the geometry and magnetic nature of $[Ni(CN)_4]^{2-}$. (At. no. of Ni = 28)

23. Calculate $\Delta_r G^\circ$ and log K_c for the following reaction :

$Cd^{2+}_{(aq)} + Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + Cd_{(s)}$

[Given : $E^\circ_{Cd^{2+}/Cd} = -0.403$ V ; $E^\circ_{Zn^{2+}/Zn} = -0.763$ V]

24. Calculate the osmotic pressure at 17°C of an aqueous solution containing 1.75 g of sucrose per 150 mL solution.

OR

The osmotic pressure of a non-volatile solute in C_6H_6 at 25°C is 20.66 Nm^{-2}. If the solution had a concentration of 2 g/dm^3, what is the molecular weight of solute?

25. Which of the following complexes (in solution) will have greater value of molar conductivity? Explain by giving reason.

(i) $K_4[Fe(CN)_6]$ and $K_3[Fe(CN)_6]$

(ii) $[Pt(NH_3)_2Cl_2]$ and $[Pt(NH_3)_6]Cl_4$

26. **(i)** Cu^{2+} salts are coloured while Zn^{2+} salts are white. Why?

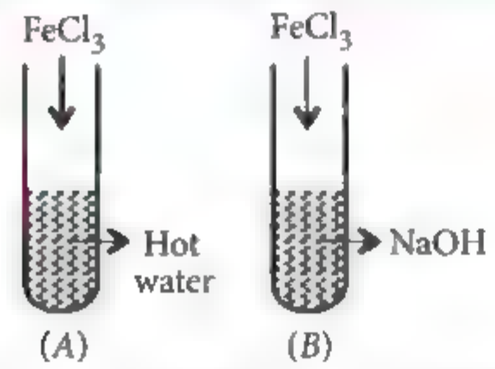
(ii) $[CuCl_4]^{2-}$ exists but $[CuI_4]^{2-}$ does not. Why?

27. Explain the mechanism of dehydration steps of ethanol :

$$CH_3CH_2OH \xrightarrow[443\ K]{H^+} CH_2=CH_2 + H_2O$$

SECTION - C

28. **(i)** A colloidal solution of ferric oxide is prepared by two different methods as shown below:



(a) What is the charge on colloidal particles in two test tubes (*A*) and (*B*)?

(b) Give reasons for the origin of charge.

(ii) What is 'occlusion'?

OR

In an adsorption experiment, a graph between $\log (x/m)$ versus $\log P$ was found to be linear with a slope of 45°. The intercept on the $\log (x/m)$ axis was found to be 0.3010. Calculate the amount of the gas adsorbed per gram of charcoal under a pressure of 0.5 atm.

29. The $E°$ values corresponding to the following two reduction electrode processes are :

$Cu^+/Cu = +0.52$ V, $Cu^{2+}/Cu^+ = +0.16$ V

Formulate the galvanic cell for their combination. What will be the standard cell potential for it? Calculate $\Delta_r G°$ for the cell reaction.

[$F = 96500$ C mol^{-1}]

30. What is lanthanoid contraction? What is its effect on the chemistry of the elements which follow the lanthanoids?

31. **(i)** Write the chemical reaction involved in Wolff-Kishner reduction.

(ii) Arrange the following in the increasing order of their reactivity towards nucleophilic addition reaction.

$C_6H_5COCH_3$, CH_3CHO, CH_3COCH_3

(iii) *A* and *B* are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer *B* forms yellow precipitate of iodoform whereas isomer *A* does not form any precipitate. Write the formulae of *A* and *B*.

OR

An organic compound (*A*) which has characteristic odour, on treatment with NaOH forms two compounds (*B*) and (*C*). Compound (*B*) has the molecular formula, C_7H_8O which on oxidation with CrO_3 gives back compound (*A*). Compound (*C*) is the sodium salt of the acid. Compound (*C*) when heated with soda lime yields an aromatic hydrocarbon (*D*). Deduce the structures of (*A*), (*B*), (*C*) and (*D*). Write chemical equations for all reactions taking place.

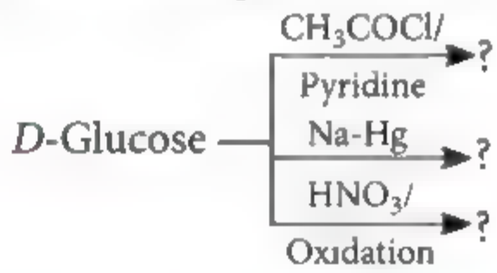
32. Explain why

(i) 4% NaOH solution (mass/volume) and 6% urea solution (mass/volume) are equimolar but not isotonic.

(ii) Aquatic species feel more comfortable in winter than in summer.

(iii) A solution of chloroform and acetone shows negative deviation from Raoult's law.

33. Complete the following reactions :



34. How will you obtain

(i) propanoic acid from ethyne

(ii) 2-methylbutanoic acid from butan-2-ol?

SECTION - D

35. **(a)** Give one chemical test to distinguish between the compounds of the following pairs:

(i) CH_3NH_2 and $(CH_3)_2NH$

(ii) Aniline and ethanamine

(b) Why aniline does not undergo Friedel–Crafts reaction?

(c) Write the chemical equation involved in the following reaction :

Hofmann bromamide degradation reaction

(d) Arrange the following in increasing order of basic strength :

$C_6H_5NH_2$, $C_6H_5NHCH_3$, $C_6H_5CH_2NH_2$

OR

(i) Write the structures of main products when benzenediazonium chloride ($C_6H_5N_2^+Cl^-$) reacts with the following reagents :

(a) HBF_4/Δ **(b)** Cu/HBr

(ii) Write the structures of A, B and C in the following reactions :

(a) $C_6H_5NO_2 \xrightarrow{Sn+HCl} A \xrightarrow[273\ K]{NaNO_2+HCl} B \xrightarrow[\Delta]{H_2O} C$

(b) $CH_3Cl \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[273\ K]{HNO_2} C$

36. (i) State reasons for the following :

(a) Rusting of iron is said to be an electrochemical phenomenon.

(b) For a weak electrolyte, its molar conductance in dilute solutions increases sharply as its concentration in solution is decreased.

(ii) Equivalent conductance of a 0.0128 N solution of acetic acid is 1.4 mho $cm^2\ eq^{-1}$ and conductance at infinite dilution is 391 mho $cm^2\ eq^{-1}$. Calculate degree of dissociation and dissociation constant of acetic acid.

OR

(i) Chromium metal is electroplated using an acidic solution containing CrO_3 according to the following equation:

$CrO_{3(aq)} + 6H^+ + 6e^- \longrightarrow Cr_{(s)} + 3H_2O$

Calculate how many grams of chromium will be electroplated by 24,000 coulombs. How long will it take to electroplate 1.5 g chromium using 12.5 A current?

[Atomic mass of Cr = 52 g mol^{-1},

1 F = 96500 C mol^{-1}]

(ii) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is 0.146×10^{-3} S cm^{-1}?

37. (i) What happens when

(a) Concentrated H_2SO_4 is added to calcium fluoride.

(b) SO_3 is passed through water?

(ii) Give at least one example to explain the following properties

(a) Sulphuric acid is a dibasic acid.

(b) Sulphuric acid is a dehydrating agent.

(c) Sulphuric acid is an oxidising agent.

OR

(i) Give reasons :

H_3PO_3 undergoes disproportionation reaction but H_3PO_4 does not.

(ii) Describe the following :

(a) Relative oxidising power of halogens.

(b) Relative acidic strength of the hydrogen halides.

(iii) Explain the following :

(a) Xenon does not form such fluorides as XeF_3 and XeF_5.

(b) Out of noble gases, only xenon is known to form real chemical compounds.

SOLUTIONS

1. Let rate of this reaction $r = k[NO]^m[Cl_2]^n$

then $\frac{r_1}{r_2} = \frac{0.60}{1.20} = \frac{k(0.15)^m(0.15)^n}{k(0.15)^m(0.30)^n}$

or $\frac{1}{2} = \left(\frac{1}{2}\right)^n \Rightarrow n = 1$

Again from $\frac{r_2}{r_3} = \frac{1.20}{2.40} = \frac{k(0.15)^m(0.30)^1}{k(0.30)^m(0.15)^1}$

or $\frac{1}{2} = \left(\frac{1}{2}\right)^m \cdot \frac{2}{1}$ or $\frac{1}{4} = \left(\frac{1}{2}\right)^m \Rightarrow m = 2$

Hence, expression for rate law is, $r = k[NO]^2[Cl_2]$

2. The order of the reaction = 2 + 1 = 3

3. The molecularity of the reaction = 3

4. Substituting the values in experiment (1),

$0.60\ M\ min^{-1} = k(0.15\ M)^2\ (0.15\ M)$

$$k = \frac{0.60\ M\ min^{-1}}{0.0225 \times 0.15\ M^3} = 177.8\ M^{-2}\ min^{-1}$$

5. In experiment no. (4),

$r = 177.8\ M^{-2}\ min^{-1} \times (0.25\ M)^2\ (0.25\ M) = 2.79\ M\ min^{-1}$

6. Equanil

7. *Tris*-(ethane-1,2-diammine) cobalt (III) sulphate

8. van Arkel method 9. Phenolphthalein

10. Teflon 11. (d) 12. (b)

13. (b) 14. (c) 15. (c)

16. (c) : Detergents with long straight chains (unbranched chains) are biodegradable.

17. (b)

18. (c) : Aldehydes with no α-hydrogen atoms, undergo Cannizzaro reaction.

19. (c) : Pine oil is used as frother which wets ore particles whereas gangue particles are wetted by water.

20. (c)

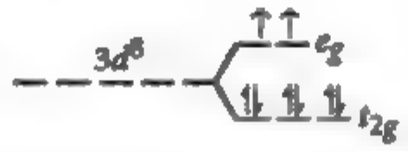
21. (i) The reactivity order for S_N1 is

$C_6H_5CH_2Br < C_6H_5CH(CH_3)Br < C_6H_5CH(C_6H_5)Br < C_6H_5C(CH_3)(C_6H_5)Br$

(ii) Alkyl halides are polar but are insoluble in water because energy required to break the intermolecular H-bonding among water molecules is much higher than energy released by water halide interaction.

22. (i) For low spin, electrons should be pair up. Nickel forms octahedral complexes mainly in +2 oxidation state which has $3d^8$ configuration. In presence of strong field ligand also it has two unpaired electrons in e_g orbital.

Hence, it does not form low spin octahedral complexes.



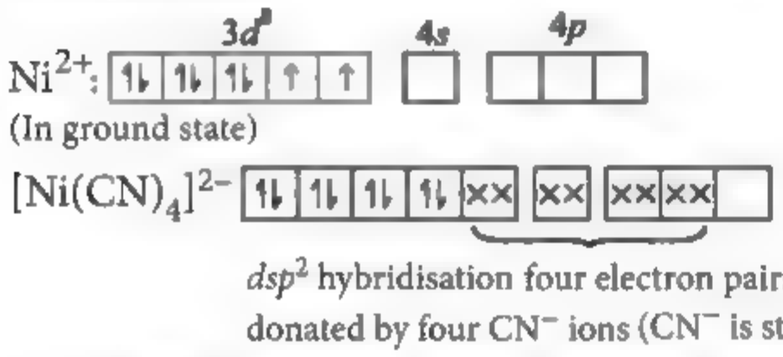
(ii) Number of ligands in tetrahedral geometry is 4 whereas in octahedral geometry it is 6.

In tetrahedral geometry, no orbital lies directly in the path of ligand whereas in octahedral geometry axial orbitals interact directly with the ligand.

This is why $\Delta_t = \frac{4}{9}\Delta_o$.

OR

In $[Ni(CN)_4]^{2-}$: Ni is present as Ni(II) with $3d^8$ configuration.



The complex ion has square planar geometry and is diamagnetic in nature.

23. $E^\circ_{cell} = E^\circ_{right} - E^\circ_{left} = -0.403 - (-0.763) = 0.36$ V

$\Delta_r G^\circ = -nFE^\circ_{cell} = -2 \times 96500 \times 0.36$

$= -69480$ J $= -69.48$ kJ

Using formula, $\log K_c = \frac{nE^\circ_{cell}}{0.0591} = \frac{2 \times 0.36}{0.0591} = 12.18$

K_c = antilog 12.18 $= 1.51 \times 10^{12}$

24. $\pi V = nRT = \frac{w}{m}RT$; $\pi \times \frac{150}{1000} = \frac{1.75}{342} \times 0.0821 \times 290$

$\pi = 0.812$ atm

OR

$\pi V = \frac{w}{m}RT \quad \therefore \quad m = \frac{w}{V}\frac{RT}{\pi}$

$m = \frac{2 \times 10^{-3} \times 8.314 \times 298}{10^{-3} \times 20.66} = 239.84$ kg mol^{-1}

25. (i) On ionisation, $K_4[Fe(CN)_6]$ gives 5 ions.

$K_4[Fe(CN)_6] \longrightarrow \underbrace{4K^+ + [Fe(CN)_6]^{4-}}_{5 \text{ ions}}$

Whereas $K_3[Fe(CN)_6]$ on ionisation gives 4 ions.

$K_3[Fe(CN)_6] \longrightarrow \underbrace{3K^+ + [Fe(CN)_6]^{3-}}_{4 \text{ ions}}$

Since, $K_4[Fe(CN)_6]$ gives more number of ions (*i.e.*, five ions) as compared to $K_3[Fe(CN)_6]$ (*i.e.*, four ions), on ionisation, $K_4[Fe(CN)_6]$ will have greater value of molar conductivity.

(ii) $[Pt(NH_3)_2Cl_2]$ is a non-electrolyte, it does not ionise in solution whereas $[Pt(NH_3)_6]Cl_4$ ionises to give 5 ions.

$[Pt(NH_3)_6]Cl_4 \longrightarrow \underbrace{[Pt(NH_3)_6]^{4+} + 4Cl^-}_{\text{five ions}}$

Hence, $[Pt(NH_3)_6]Cl_4$ will have greater molar conductivity as compared to $[Pt(NH_3)_2Cl_2]$.

26. (i) Zn^{2+} ion has completely filled *d*-subshell and no *d-d* transition is possible. So, zinc salts are white. Configuration of Cu^{2+} is [Ar] $3d^9$. It has partly filled *d*-subshell and hence, it is coloured due to *d-d* transition.

(ii) I^- ion is a stronger reducing agent than Cl^- ion, therefore I^- ion reduces Cu^{2+} to Cu^+ ion. As a result CuI_2 is converted into CuI and hence $[CuI_4]^{2-}$ does not exist.

27. *Refer to answer 36, Page no. 185* (MTG CBSE Champion Chemistry Class 12).

28. (i) **(a)** Colloidal particles of test tube (*A*) are positively charged whereas colloidal particles of test tube (*B*) are negatively charged.

(b) In test tube (*A*), Fe^{3+} ions are adsorbed on the ppt. of $Fe_2O_3 \cdot xH_2O$ or $Fe_2O_3 \cdot xH_2O/Fe^{3+}$ is formed.

In test tube (*B*), OH^- ions are adsorbed on the ppt. of $Fe_2O_3 \cdot xH_2O$ or $Fe_2O_3 \cdot xH_2O/OH^-$ is formed.

(ii) The adsorption of gases on the surface of metals is called occlusion.

OR

According to the Freundlich equation,

$\frac{x}{m} = kP^{1/n}$ or $\log\frac{x}{m} = \log k + \frac{1}{n}\log P$

$\therefore$ Plot of $\log x/m$ versus $\log P$ is linear with slope $= 1/n$ and intercept $= \log k$. Thus, $1/n = \tan 45^\circ = 1 \Rightarrow n = 1$

$\log k = 0.3010$ or k = antilog $0.3010 = 2$

At $P = 0.5$ atm, $x/m = kP^{1/n} = 2 \times (0.5)^1 = 1.0$ g

29. At cathode : $Cu^+ + e^- \longrightarrow Cu$, $E^\circ = +0.52$ V

At anode : $Cu^+ \longrightarrow Cu^{2+} + e^-$, $E^\circ = +0.16$ V

Cell reaction : $2Cu^+ \longrightarrow Cu + Cu^{2+}$

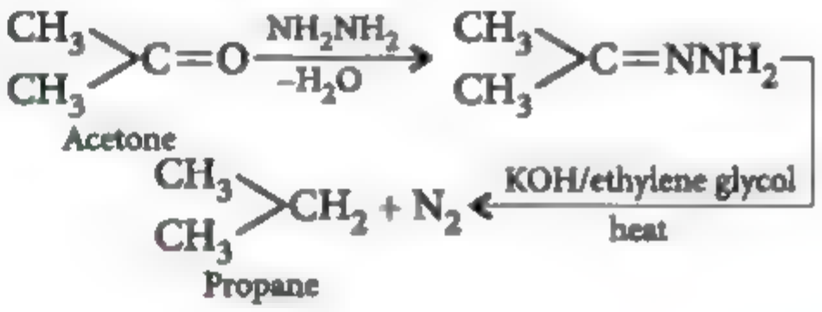
Cell representation is $Cu^+ \mid Cu^{2+} \parallel Cu^+ \mid Cu$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.52 - 0.16 = 0.36$ V

$\Delta_r G^\circ = -nE^\circ F = -1 \times 0.36 \times 96500 = -34740$ J mol^{-1}

30. *Refer to answer 110, Page no. 131* (MTG CBSE Champion Chemistry Class 12).

31. (i)



(ii) Increasing order of reactivity towards nucleophilic addition reaction :

$C_6H_5COCH_3 < CH_3COCH_3 < CH_3CHO$

(c) Formula of compounds *A* and *B* is C_3H_6O, *B* forms yellow precipitate of iodoform. Hence, *B* must contain $-COCH_3$ group. Therefore, compound '*B*' must be CH_3COCH_3.

A does not give iodoform test and it is functional isomer of *B* thus, it may be CH_3CH_2CHO.

OR

$$\underset{\text{'A'}}{C_6H_5CHO} \xrightarrow{NaOH} \underset{\text{'B'}\ (C_7H_8O)}{C_6H_5CH_2OH} + \underset{\text{'C'}\ \text{(Sodium salt of benzoic acid)}}{C_6H_5COONa}$$

$$\underset{\text{'B'}}{C_6H_5CH_2OH} \xrightarrow{CrO_3} \underset{\text{'A'}}{C_6H_5CHO}$$

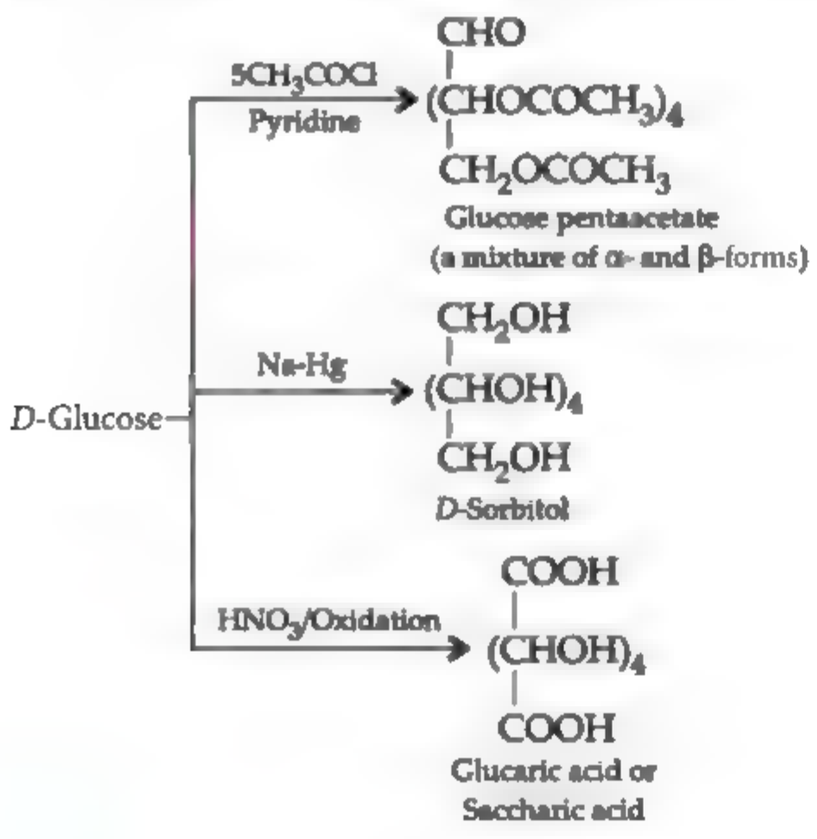
$$\underset{\text{'C'}}{C_6H_5COONa} \xrightarrow[\Delta]{NaOH/CaO} \underset{\text{'D'}\ \text{(Benzene) (Aromatic)}}{C_6H_6} + Na_2CO_3$$

32. (i) Both the solutions 4% NaOH (*m*/*V*) and 6% urea (*m*/*V*) have same concentration (1 M) but these are not isotonic because NaOH undergoes dissociation in solution but urea does not. Therefore, number of particles in NaOH solution is more than that in urea solution.

(ii) In winter season at low temperature, solubility of oxygen in water is higher than that in summer at high temperature. Hence, aquatic species feel more comfortable in winter than in summer.

(iii) A mixture of chloroform and acetone shows negative deviation from Raoult's law because chloroform molecule forms H-bonding with acetone molecule. As a result of this, *A*—*B* interaction becomes stronger than *A*—*A* and *B*—*B* interactions. This leads to the decrease in vapour pressure and resulting in negative deviation.

33.



34. (i) $\underset{\text{Ethyne}}{HC \equiv CH} \xrightarrow[Hg^{2+}]{HCl} H_2C = CHCl \xrightarrow[\text{Ether}]{Mg}$

$$H_2C = CHMgCl \xrightarrow{CO_2} H_2C = CHCOOMgCl \xrightarrow{H^+}$$

$$H_2C = CHCOOH \xrightarrow{H_2/Pd} \underset{\text{Propanoic acid}}{CH_3CH_2COOH}$$

(ii) $CH_3CH_2\underset{\underset{OH}{|}}{CH}CH_3 \xrightarrow[-SO_2,\ -HCl]{SOCl_2} CH_3CH_2\underset{\underset{Cl}{|}}{CH}CH_3 \xrightarrow[\text{Ether}]{Mg}$

Butan-2-ol

$$C_2H_5CH(CH_3)MgCl \xrightarrow{CO_2} C_2H_5CH(CH_3)COOMgCl$$

$$\underset{\text{2-Methylbutanoic acid}}{C_2H_5CH(CH_3)COOH} \xleftarrow[-Mg(OH)Cl]{H^+/H_2O} C_2H_5CH(CH_3)COOMgCl$$

35. (a) (i) : Methylamine gives carbylamine test, *i.e.*, on treatment with *alc.* KOH and chloroform, followed by heating it gives offensive odour of methyl isocyanide. Dimethylamine does not give this test.

(ii) Aniline being an aromatic primary amine on treatment with HNO_2 at 273–278 K followed by treatment with an alkaline solution of β-naphthol gives an orange coloured azo dye. Ethylamine does not give this test.

(b) In Friedel-Crafts reaction, $AlCl_3$ is added as a catalyst which is a Lewis acid. It forms a salt with aniline due to which the nitrogen of aniline acquires positive charge. This positively charged nitrogen acts as a strong deactivating group, hence aniline does not undergo Friedel — Crafts reaction.

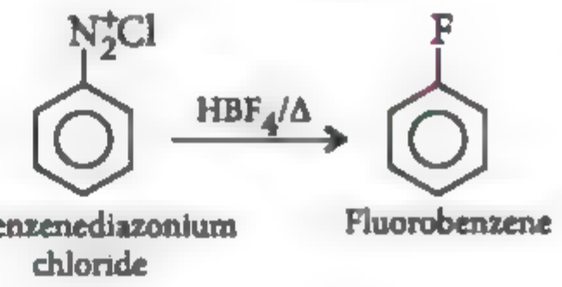
(c) $\underset{\text{Acid amide}}{R—CONH_2} + Br_2 + 4NaOH \rightarrow$

$$\underset{\text{1° amine}}{R — NH_2} + Na_2CO_3 + 2NaBr + 2H_2O$$

(d) $C_6H_5NH_2 < C_6H_5NHCH_3 < C_6H_5CH_2NH_2$

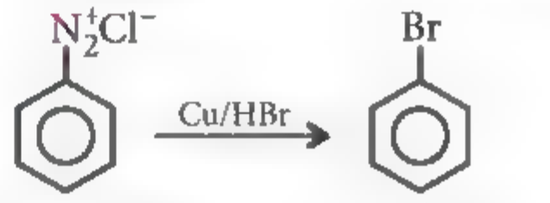
OR

(i) (a)



Benzenediazonium chloride — Fluorobenzene

(b)



Benzenediazonium chloride — Bromobenzene

(ii) (a) *Refer to answer 50 (i), Page no. 229* (MTG CBSE Champion Chemistry Class 12).

(b) *Refer to answer 66 (ii), Page no. 231* (MTG CBSE Champion Chemistry Class 12).

36. (i) (a) According to electrochemical theory during the formation of rust the impure iron surface behaves like a small electrochemical cell. In such cells pure iron acts as anode and impure surface acts as cathode. Moisture containing dissolved O_2 or CO_2 is the electrolytic solution. Hence, rusting is an electrochemical phenomenon.

(b) On dilution, the degree of ionisation of the weak electrolyte increases. This increases the molar conductance of the solution sharply.

(ii) Given : $\Lambda_{eq} = 1.4$ mho cm^2 eq^{-1},

$\Lambda^{\circ}_{eq} = 391$ mho cm^2 eq^{-1}, $\alpha = ?$ $K_a = ?$

Using formula, $\alpha = \dfrac{\Lambda_{eq}}{\Lambda^{o}_{eq}} = \dfrac{1.4 \text{ mho cm}^2 \text{ eq}^{-1}}{391 \text{ mho cm}^2 \text{ eq}^{-1}}$

$= 0.00358$

$$K_a = \frac{\alpha^2 C}{1-\alpha} = \frac{(0.00358)^2 \times 0.0128}{1 - 0.00358} = 1.6 \times 10^{-7}$$

OR

Refer to answer 80, Page no. 41 (MTG CBSE Champion Chemistry Class 12).

(ii) Conductivity (κ) = 0.146×10^{-3} S cm^{-1},

resistance (R) = 1500 Ω

$$\text{Cell constant} = \frac{\text{Conductivity}}{\text{Conductance}}$$

= Conductivity × Resistance

= $\kappa \times R = 0.146 \times 10^{-3} \times 1500 = 0.219$ cm^{-1}

37. (i) (a) $CaF_2 + H_2SO_4 \longrightarrow CaSO_4 + 2HF$

(b) $SO_3 + H_2O \longrightarrow H_2SO_4$

SO_3 dissolves in water to form H_2SO_4.

(ii) (a) In aqueous solution, H_2SO_4 ionizes in two steps :

$H_2SO_4 \longrightarrow H^+ + HSO_4^-$

$HSO_4^- \longrightarrow H^+ + SO_4^{2-}$

Thus, H_2SO_4 acts as a strong dibasic acid and forms two series of salts-normal sulphates such as sodium sulphate and acid sulphates such as sodium bisulphate.

$NaOH + H_2SO_4 \longrightarrow \underset{\text{Sodium hydrogen sulphate (acid salt)}}{NaHSO_4} + H_2O$

$2NaOH + H_2SO_4 \longrightarrow \underset{\text{Sodium sulphate (normal salt)}}{Na_2SO_4} + 2H_2O$

(b) H_2SO_4 has great affinity for water molecules and hence, it acts as a dehydrating agent.

$$\underset{\text{Oxalic acid}}{(COOH)_2} \xrightarrow{\text{Conc. } H_2SO_4} H_2O + CO + CO_2$$

(c) H_2SO_4 oxidises metals, non-metals and other compounds.

$Cu + 2H_2SO_4(\text{conc.}) \longrightarrow CuSO_4 + SO_2 + 2H_2O$

$S_8 + 16H_2SO_4 \longrightarrow 24SO_2 + 16H_2O$

$2NaBr + 3H_2SO_4 \longrightarrow 2NaHSO_4 + SO_2 + Br_2 + 2H_2O$

OR

(i) The oxoacid of phosphorus containing +3 oxidation state, undergoes disproportionation to yield compounds in higher and lower oxidation states. Hence, H_3PO_3 undergoes disproportionation reaction but H_3PO_4 does not, as in it phosphorus is already in highest oxidation state (+5).

(ii) (a) From top to bottom in group-17 oxidising power of halogens decreases.

$F_2 > Cl_2 > Br_2 > I_2$.

(b) The acidic strength of the hydrohalic acids increases in the order : HF < HCl < HBr < HI

This order is a result of bond dissociation enthalpies of H — *X* bond, which decreases from H — F to H — I as the size of halogen atom increases.

(iii) *Refer to answer 132, Page no. 112* (MTG CBSE Champion Chemistry Class 12).

10 MUST KNOW TIPS TO SCORE ABOVE 95% IN CHEMISTRY CBSE BOARD EXAM 2020

Here are the 10 must know tips to score high in Chemistry :

1 Division of Marks

In Chemistry, out of 70 marks, 20 marks will be given to objective type questions which will include MCQs, paragraph based questions, assertion and reason type questions, and one-word answer type questions. Thus out of 70 marks, only 50 will be given to the subjective type questions where the students are required to write the detailed answers.

It seems that objective questions will be easier than subjective questions but the students must know that to answer these questions; they have to study each and every topic with proper understanding

2 Preparation from NCERT is the Most Important Step

In chemistry, the question paper is entirely based on the content from NCERT books, so the students need to prepare from NCERT. They should go through the entire content, every diagram, every graph, explanation under the diagram, footnote, etc.

They need to practice all the intext NCERT questions, solved examples and exercise questions from all the chapters many times.

Refer to MTG NCERT Textbook + Exemplar Problems Solutions Class 12

3 Important Units/Chapters

Generally, 5 marks questions are asked from the following units/ chapters :

1. Electrochemistry
2. Chemical Kinetics
3. The *p*-Block elements
4. The *d*- and *f*-Block Elements
5. Aldehydes, Ketones and Carboxylic Acids.

Students should concentrate more on the above-stated units.

4 Written Practice

Chemical equations from both organic and inorganic chemistry are easy to understand but difficult to learn. Students should practise these reactions by writing them as much as possible.

5 Solving Numericals : For solving numerical questions, keep the following things in mind :

- First, write all the information provided, then write the formula and put all the values with their units.
- At last, instead of giving much time to calculations, leave space for the numerical value in answer, but write unit.
- After completing the paper, do calculations for the final answer to the numerical questions.

Sometimes, students are too much involved in calculations, that later they fail to manage time and the entire exam gets affected.

6 Preparation of Organic Chemistry

Students should write named reactions, tests to distinguish between compounds and conversions from all the units of organic chemistry altogether in the form of notes and then do written practice of them many times.

7 Preparation of Inorganic Chemistry

Generally, three types of questions are asked from inorganic chemistry viz. to complete the equations, to draw the structures and conceptual questions. Conceptual questions and structures are easier to prepare than equations, so students should give preference to these questions. If there is an internal choice in the questions of inorganic chemistry, give preference to structures and conceptual rather than to equations.

8 Preparation of Tail Chapters

Often we say that the last three chapters of 'Biomolecules', 'Polymers' and 'Chemistry in Everyday Life' are tail chapters. These three chapters are very scoring; students should prepare very short notes of these chapters in tabular form and should have a quick review of them.

9 Solving Previous Years' Question Papers

Students should solve the previous years' question papers like mock tests because while solving the question papers of previous years, students understand the time management and develop the temperament of facing the challenges of the exam.

10 Solving Sample Papers

Students should solve at least 10 sample papers of Chemistry. It will definitely improve their confidence and prepare them to face the challenges.

Refer to MTG 21 ScoreMore Chemistry Class 12

All the best for your board exams.

MONTHLY TEST DRIVE

This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

The *p*-Block Elements (Group 15 to 18)

Total Marks : 120 Time Taken : 60 Min.

NEET

Only One Option Correct Type

1. Regular use of which of the following fertilizers increases the acidity of soil?
   (a) Ammonium sulphate
   (b) Potassium nitrate
   (c) Urea
   (d) Superphosphate of lime

2. Which has maximum pH in aqueous solution ?
   (a) NaClO (b) $NaClO_2$
   (c) $NaClO_3$ (d) $NaClO_4$

3. Which of the following pairs are isostructural ?
   (a) XeF_2, IF_2^- (b) NH_3,BF_3
   (c) CO_3^{2-}, SO_3^{2-} (d) PCl_5, ICl_5

4. Choose the incorrect statement among the following.
   (a) In vapour state, Cl_2O_6 exists as ClO_3 monomer having one unpaired electron and is paramagnetic in nature.
   (b) In solid state, it is diamagnetic and dimeric, having all the electrons paired
   (c) In Cl_2O_6, Cl is d^2sp^3 hybridized.
   (d) In Cl_2O_6, Cl is sp^3 hybridized.

5. Which of the following reactions is incorrectly matched ?
   (a) $CsBr_3 \rightleftharpoons Cs^+ + Br_3^-$
   (b) $I_4O_9 \rightleftharpoons I^{3+} + 3(IO_3)^-$
   (c) $AgBrO_3 \rightleftharpoons Ag^+ + BrO_3^-$
   (d) $I_2O_4 \rightleftharpoons IO_2^+ + IO_2^-$

6. When concentrated H_2SO_4 is heated with P_2O_5, the acid is converted into
   (a) a mixture of sulphur dioxide and sulphur trioxide
   (b) sulphur trioxide
   (c) sulphur dioxide (d) sulphur.

7. The decreasing order of the boiling points of the following hydrides is
   (i) NH_3 (ii) PH_3 (iii) AsH_3 (iv) SbH_3 (v) H_2O
   (a) (v) > (iv) > (i) > (iii) > (ii)
   (b) (v) > (i) > (ii) > (iii) > (iv)
   (c) (ii) > (iv) > (iii) > (i) > (v)
   (d) (iv) > (iii) > (i) > (ii) > (v)

8. $X \xrightarrow{KOH} Y$ (gas turns red litmus to blue) + Z
   $X \xrightarrow{Zn + KOH} Y$
   $X \xrightarrow{\Delta}$ gas (support combustion)
   Identify (X) to (Z).
   (a) $X = NH_4NO_2$, $Y = NH_3$, $Z = KNO_2$
   (b) $X = (NH_4)_2Cr_2O_7$, $Y = NH_3$, $Z = Cr_2O_3$
   (c) $X = (NH_4)_2SO_4$, $Y = NH_3$, $Z = K_2SO_4$
   (d) $X = NH_4NO_3$, $Y = NH_3$, $Z = KNO_3$

9. When F_2 reacts with hot and conc. alkali, then which of the following will be obtained ?
   (i) OF_2 (ii) O_2 (iii) H_2O (iv) NaF
   (a) (i), (iii) and (iv) (b) (i), (ii) and (iii)
   (c) (ii), (iii) and (iv) (d) all of these

10. Phosphorous acid on heating gives the following products :
    $$4H_3PO_3 \xrightarrow{\Delta} 3H_3PO_4 + PH_3$$
    The above reaction is an example of
    (a) oxidation
    (b) thermal decomposition
    (c) disproportionation
    (d) reduction.

11. $MF + XeF_4 \rightarrow A$ (where M^+ is alkali metal cation); the hybridization of central atom of A and its shape are

(a) sp^3d, trigonal bipyramidal
(b) sp^3d^3, distorted octahedral
(c) sp^3d^3, pentagonal planar
(d) no such compound is formed.

12. Which one of the following orders correctly represents the increasing acidic strengths of the given acids?
(a) $HOClO < HOCl < HOClO_3 < HOClO_2$
(b) $HOClO_2 < HOClO_3 < HOClO < HOCl$
(c) $HOClO_3 < HOClO_2 < HOClO < HOCl$
(d) $HOCl < HOClO < HOClO_2 < HOClO_3$

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** H—S—H bond angle in H_2S is closer to 90° but H—O—H bond angle in H_2O is 104.5°.
Reason : Lone pair-lone pair repulsion is stronger in H_2S than in H_2O

14. **Assertion :** Concentrated sulphuric acid cannot be used for the preparation of HBr from NaBr.
Reason : HBr being strong reducing agent, reduces H_2SO_4 to SO_2 and is itself oxidised to Br_2.

15. **Assertion :** For drying ammonia gas, the common dehydrating agents like H_2SO_4, $CaCl_2$ or P_2O_5 cannot be used.
Reason : H_2SO_4, $CaCl_2$ or P_2O_5 react with NH_3.

JEE MAIN / ADVANCED

Only One Option Correct Type

16. An inorganic halide (*A*) reacts with water to form two acids (*B*) and (*C*). (*A*) also reacts with NaOH to form two salts (*D*) and (*E*) which remain in solution. The solution gives white precipitate with both $AgNO_3$ and $BaCl_2$ solutions respectively. (*A*) is a useful organic reagent. The compound (*A*) is
(a) $SOCl_2$ (b) SO_2Cl_2 (c) S_2Cl_2 (d) SF_4

17. An amorphous solid (*X*) burns in air to form a gas (*Y*) which turns limewater milky. This gas decolourises aqueous solution of acidified $KMnO_4$. Gas (*Y*) reacts with oxygen to give another gas (*Z*) which is responsible for acid rain. *X*, *Y* and *Z* are

	X	*Y*	*Z*
(a)	C	CO	CO_2
(b)	S	SO_2	SO_3
(c)	P	P_2O_3	P_2O_5
(d)	S	SO_3	H_2SO_4

18. A colourless inorganic salt (*A*) decomposes completely at about 523 K to give only two products (*B*) and (*C*) leaving no residue. The product (*B*) is a neutral gas while the product (*C*) is liquid at room temperature and is neutral to litmus. White phosphorus burns in excess of (*B*) to produce a strong dehydrating agent P_4O_{10}. The compounds (*A*), (*B*) and (*C*) are respectively
(a) NH_4NO_2, N_2, H_2O (b) NH_4NO_3, N_2O, H_2O
(c) NH_4Cl, NH_3, HCl (d) $NaNO_3$, O_2, $NaNO_2$

19 $Xe_{(g)} + PtF_{6(g)} \longrightarrow A \xrightarrow[25°C]{PtF_6} B \xrightarrow[60°C]{PtF_6} C$
A, *B* and *C* respectively are
(a) $Xe^+[PtF_6]^-$, $[XeF]^+[Pt_2F_{11}]^-$, $[XeF]^+[Pt_3F_{16}]^-$
(b) $[XeF]^+[PtF_6]^-$, $[XeF]^+[Pt_2F_{11}]^-$, $[XeF]^+[Pt_3F_{16}]^-$
(c) $[XeF]^+[PtF_6]^-$, $[XeF_2]^+[Pt_2F_{11}]^-$, $[XeF_3]^+[Pt_3F_{16}]^-$
(d) $Xe^+[PtF_6]^-$, $[XeF]^+[PtF_6]^-$, $[XeF]^+[Pt_2F_{11}]^-$

More than One Options Correct Type

20. Which of the following statements about sulphur are correct ?
(a) Sulphur exists as S_8 octaatomic molecule with puckered ring structure.
(b) In S_8 molecule, each S atom is sp^3- hybridized involving both bonding and non-bonding pairs of electrons.
(c) S_8 molecule is associated with 8 S—S bonds and 16 lone pairs.
(d) The S—S—S bond angle in S_8 molecule is 109.5°.

21. Which of the following reactions can evolve phosphine?
(a) White P + $Ca(OH)_2$ ⟶
(b) AlP + H_2SO_4 ⟶
(c) $H_3PO_3 \xrightarrow{Heat}$
(d) PH_4I + NaOH ⟶

22. Which amongst the following statements are correct?
(a) XeF_4 and SbF_5 combine to form salt.
(b) He and Ne do not form clathrates.
(c) He has highest boiling point in its group.
(d) Mixture of He and O_2 is used for respiration by sea divers.

23. Astatine is the element below iodine in group 17 in periodic table. Which of the following statements are true for astatine ?
(a) It is less electronegative than iodine.
(b) It exhibits only –1 oxidation state.
(c) It is composed of diatomic molecules.
(d) Intermolecular forces will be larger than iodine.

Numerical Value Type

24. Fluorine reacts with cold and dilute NaOH solution to give NaF, H_2O and *X*. It also reacts with hot and concentrated NaOH to give NaF, H_2O and *Y*. The difference in the oxidation states of O in *X* and *Y* is

25. Sodium iodate is treated with calculated amount of sodium bisulphite to prepare iodine. How many moles of sodium bisulphite are required to prepare one mole of iodine from sodium iodate ?

26. Among the following, the number of compounds that can react with PCl_5 to give $POCl_3$ is
O_2, CO_2, SO_2, H_2O, H_2SO_4, P_4O_{10}

Matrix Match Type

Answer the following questions (27 and 28) by appropriately matching the columns based on the information given in the passage :

All the halogens combine directly with hydrogen to form covalent molecular hydrides. The reactivity of the halogens decreases from fluorine to iodine. Aqueous solutions of hydrogen halides are known as hydrohalic acids. These can be prepared by heating their respective salts with acids.

Column-I		Column-II	
(P)	Euchlorine	I.	$KClO_3$
(Q)	Berthelots salts	II.	$CCl_3.NO_2$
(R)	Anhydrone	III.	$ClO_2 + Cl_2$
(S)	Tear gas	IV.	$Mg(ClO_4)_2$

27. Which of the following has the correct combination considering column-I and column-II?
(a) P → I (b) Q → IV (c) R → III (d) S → II

28. Which of the following has the correct combination considering column-I and column-II?
(a) P → III (b) Q → II
(c) R → I (d) S → IV

Answer the following questions (29 and 30) by appropriately matching the columns based on the information given in the passage :

The binary compounds of oxygen with other elements are called oxides. They are classified either depending upon their acid-base characteristics or on the basis of oxygen content.

(a) **Normal oxides :** These oxides which contain oxygen atoms as permitted by the normal oxidation number, *i.e.*, –2. Normal oxide may be acidic, basic, amphoteric or neutral.

(b) **Polyoxides :** The oxides which contain oxygen atoms different than those permitted by the normal oxidation number of –2.
(i) **Peroxides :** Two oxygen atoms are linked to each other and each oxygen has –1 oxidation number. They contain $(O—O)^{2-}$ unit.
(ii) **Superoxides :** These oxides contain $(O—O)^-$ unit. *i.e.*, each O-atom has oxidation number –1/2.
(iii) **Suboxides :** These contain low content of oxygen than expected.
(iv) **Mixed oxides :** These oxides are made of two simpler oxides.

Column-I (Oxides)		Column-II (Species)	
(P)	Suboxides	I.	Pb_3O_4, Fe_3O_4
(Q)	Mixed oxides	II.	N_2O, C_3O_3
(R)	Amphoteric oxides	III.	CO, NO
(S)	Neutral oxides	IV.	BeO, Al_2O_3

29. Which of the following has the correct combination considering column-I and column-II?
(a) P → II (b) Q → IV (c) R → III (d) S → I

30. Which of the following has the correct combination considering column-I and column-II?
(a) P → III (b) Q → I
(c) R → IV (d) S → II

Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

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Exam on May 3, 2020

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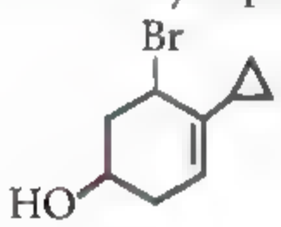
Only One Option Correct Type

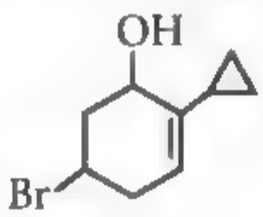
1. At moderate pressure, the van der Waals' equation is reduced to

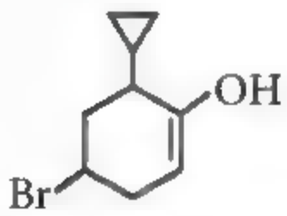
   (a) $Z = \frac{pV_m}{RT} = 1 - \frac{aP}{RT}$ (b) $Z = \frac{pV_m}{RT} = 1 + \frac{b}{RT}p$

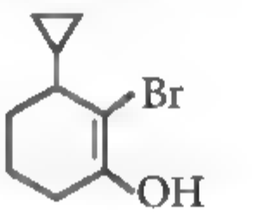
   (c) $pV_m = RT + a/V^2$ (d) $Z = \frac{pV_m}{RT} = 1 - \frac{a}{RT}$

2. Which of the following is the correct structure of 5-bromo-2-cyclopropylcyclohex-2-en-1-ol?

   (a) 

   (b) 

   (c) 

   (d) 

3. Which of the following is the correct statement?
   (a) CO which is major pollutant resulting from the combustion of fuels in automobiles plays a major role in photochemical smog.
   (b) Classical smog has an oxidizing character while the photochemical smog is reducing in character.
   (c) Photochemical smog occurs in day time whereas the classical smog occurs in early morning hours.
   (d) During formation of smog the level of ozone in the atmosphere goes down.

4. A metal (M) burns with dazzling brilliance in air to give a white powder. The white powder reacts with water to form a white precipitate and a colourless gas with a characteristic smell. The metal (M) decomposes hot water but not cold water, liberating the inflammable hydrogen gas. The metal (M) is
   (a) K (b) Ca (c) Mg (d) Rb

5. Enthalpy of formation of gaseous H_2O at 298 K is –241.8 kJ mol^{-1}. What would be its value at the standard boiling point of water?
   Given the following value of molar heat capacities (C_p) at constant pressure (assume them to be temperature independent).
   $C_p(H_2O_{(g)}) = 33.58\ JK^{-1}mol^{-1}$;
   $C_p(H_2) = 28.90\ JK^{-1}\ mol^{-1}$;
   $C_p(O_2) = 29.39\ JK^{-1}\ mol^{-1}$
   (a) $-231.05\ kJ\ mol^{-1}$ (b) $-242.55\ kJ\ mol^{-1}$
   (c) $-991.8\ kJ\ mol^{-1}$ (d) $242.55\ kJ\ mol^{-1}$

6. If radiation corresponding to second line of "Balmer series" of Li^{2+} ion, knocked out electron from first excited state of H-atom, then kinetic energy of ejected electron would be
(a) 2.55 eV (b) 4.25 eV
(c) 11.25 eV (d) 19.55 eV

7. Which of the following statements is wrong?
(a) van der Waals' radius of iodine is more than its covalent radius.
(b) All isoelectronic ions belong to same period of the periodic table.
(c) $I.E._1$ of N is higher than that of O while $I.E._2$ of O is higher than that of N.
(d) The electron affinity of N is almost zero while that of P is 74.3 kJ mol^{-1}.

8. The pH of 0.1 M solution of the following compounds increases in the order
(a) $NaCl < NH_4Cl < NaCN < HCl$
(b) $HCl < NH_4Cl < NaCl < NaCN$
(c) $NaCN < NH_4Cl < NaCl < HCl$
(d) $HCl < NaCl < NaCN < NH_4Cl$

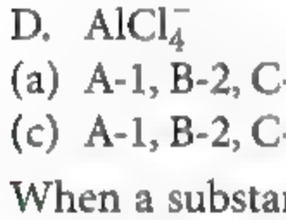
9. Match List-I with List-II and select the correct answer.

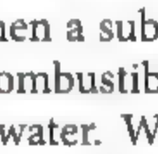
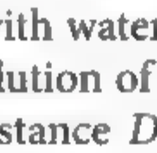
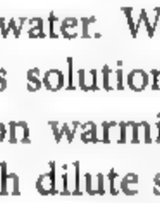
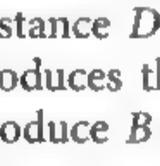
List-I (ion)		List-II (shapes)
A.	ICl_2^-	1. Linear
B.	ClO_3^-	2. Pyramidal
C.	ClF_4^-	3. Tetrahedral
D.	$AlCl_4^-$	4. Square planar

(a) A-1, B-2, C-3, D-4 (b) A-4, B-1, C-2, D-3
(c) A-1, B-2, C-4, D-3 (d) A-2, B-1, C-3, D-4

10. When a substance *A* reacts with water it produces a combustible gas *B* and a solution of substance *C* in water. When another substance *D* reacts with this solution of *C*, it also produces the same gas *B* on warming but *D* can produce *B* on reaction with dilute sulphuric acid at room temperature. *A* imparts a golden yellow colour to a smokeless flame of Bunsen flame. *A*, *B*, *C* and *D* are respectively
(a) K, H_2, KOH and Al
(b) Na, H_2, NaOH and Zn
(c) CaC_2, C_2H_2, $Ca(OH)_2$ and Fe
(d) Ca, H_2, $Ca(OH)_2$ and Sn

11. Predict the product (*A*) of the following reaction



(a) 
(b) 
(c) 
(d) 

12. 3.92 g of ferrous ammonium sulphate crystals are dissolved in 100 mL of water. 20 mL of this solution requires 18 mL of potassium permanganate during titration for complete oxidation. The weight of $KMnO_4$ present in one litre of the solution is
(a) 3.476 g (b) 12.38 g (c) 1.238 g (d) 34.76 g.

13. In which of the following reactions, H_2O_2 acts as a reducing agent?
(a) $PbO_{2(s)} + H_2O_{2(aq)} \longrightarrow PbO_{(s)} + H_2O_{(l)} + O_{2(g)}$
(b) $Na_2SO_{3(aq)} + H_2O_{2(aq)} \longrightarrow Na_2SO_{4(aq)} + H_2O_{(l)}$
(c) $2KI_{(aq)} + H_2O_{2(aq)} \longrightarrow 2KOH_{(aq)} + I_{2(s)}$
(d) $KNO_{2(aq)} + H_2O_{2(aq)} \longrightarrow KNO_{3(aq)} + H_2O_{(l)}$

14. On addition of increasing amount of $AgNO_3$ to 0.1 M each of NaCl and NaBr in a solution, what % of Br^- ion get precipitated when Cl^- ion starts precipitating? $K_{sp}(AgCl) = 1.0 \times 10^{-10}$, K_{sp} (AgBr) $= 1 \times 10^{-13}$
(a) 0.11 (b) 99.9 (c) 0.01 (d) 9.99

15. The following redox reaction is balanced by which set of coefficients?
$aZn + bNO_3^- + cH^+ \longrightarrow dNH_4^+ + eH_2O + fZn^{2+}$

	a	*b*	*c*	*d*	*e*	*f*
(a)	1	1	10	1	3	1
(b)	2	2	10	2	3	2
(c)	4	2	10	1	3	4
(d)	4	1	10	1	3	4

SOLUTIONS

1. **(a) :** van der Waals' equation is

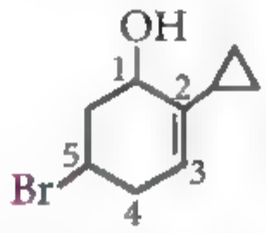
$$\left(p + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

where, $V_m = V/n$ = molar volume. At moderate pressure, V_m is high and b can be ignored.

$$\therefore \quad \left(p + \frac{a}{V_m^2}\right)V_m = RT \text{ or } pV_m + \frac{a}{V_m} = RT$$

$$\therefore \quad pV_m = RT - \frac{a}{V_m} \text{ or } \frac{pV_m}{RT} = 1 - \frac{a}{RTV_m}$$

$$\text{or} \quad Z = 1 - \frac{a}{RTV_m} = 1 - \frac{aP}{RT} \qquad \left(\text{since } V \propto \frac{1}{P}\right)$$

2. **(b) :** 

5-Bromo-2-cyclopropylcyclohex-2-en-1-ol

3. **(c) :** Photochemical smog occurs in summers during day time whereas classical smog is formed in the early morning hours of winter months.

4. **(c) :** Hydrogen is liberated when Mg reacts with hot water. Rb, K and Ca gives hydrogen gas even with cold water.

$Mg + O_2 \rightarrow MgO$; $Mg + N_2 \rightarrow Mg_3N_2$

$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3\uparrow$

$Mg + 2H_2O$ (hot) $\rightarrow Mg(OH)_2 + H_2$

5. (b) : $H_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow H_2O_{(g)}$

$\Delta C_p = C_p(H_2O) - C_p(H_2) - \frac{1}{2} C_p(O_2)$

$= 33.58 - (28.90 + \frac{1}{2} \times 29.39) = -10\ JK^{-1}$

$\Delta H_2 - \Delta H_1 = \Delta C_p(T_2 - T_1)$;

$\Delta H_2 - \Delta H_1 = \Delta C_p(373 - 298)$

$\Delta H_2 - (-241.8\ kJ\ mol^{-1}) = \frac{-10 \times 75}{1000}\ kJ$

$\Delta H_2 + 241.8 = -0.75$

$\Delta H_2 = -0.75 - 241.8 = -242.55\ kJ\ mol^{-1}$

6. (d) : Energy of photon corresponding to second line of Balmer series for Li^{2+} ion

$= (13.6) \times (3)^2 \left[\frac{1}{2^2} - \frac{1}{4^2}\right] = 13.6 \times \frac{27}{16}$

$\therefore$ Z for Li = 3

$n_1 = 2$ (Balmer series) ; $n_2 = 4$ (Balmer series second line)

Energy needed to eject electron from n = 2 level in H-atom;

$= 13.6 \times 1^2 \times \left[\frac{1}{2^2} - \frac{1}{\infty^2}\right] \Rightarrow \frac{13.6}{4}$

$\therefore$ $Z = 1$ (H-atom)

$n_1 = 2$ (First excited state), $n_2 = \infty$

K.E. of ejected electron will be the difference in these two energies

$= 13.6 \times \frac{27}{16} - \frac{13.6}{4} = 13.6 \times \left(\frac{27-4}{16}\right) = 19.55\ eV$

7. (b)

8. (b) : (i) $\underset{0.1\ M}{HCl} \longrightarrow \underset{0.1\ M}{H^+} + Cl^-$

$\therefore$ $[H^+] = 0.1$ M

$pH = -\log[H^+] = -\log 0.1 = 1$

(ii) NaCl is a salt of strong acid and strong base so it is not hydrolysed and hence its pH is 7.

(iii) $NH_4Cl + H_2O \rightleftharpoons NH_4OH + HCl$

$\therefore$ The solution is acidic and its pH is less than that of 0.1 M HCl.

(iv) $NaCN + H_2O \rightleftharpoons NaOH + HCN$

$\therefore$ The solution is basic and its pH is more than that of 0.1 M HCl.

$\therefore$ Correct order for increase in pH is

$HCl < NH_4Cl < NaCl < NaCN$.

9. (c)

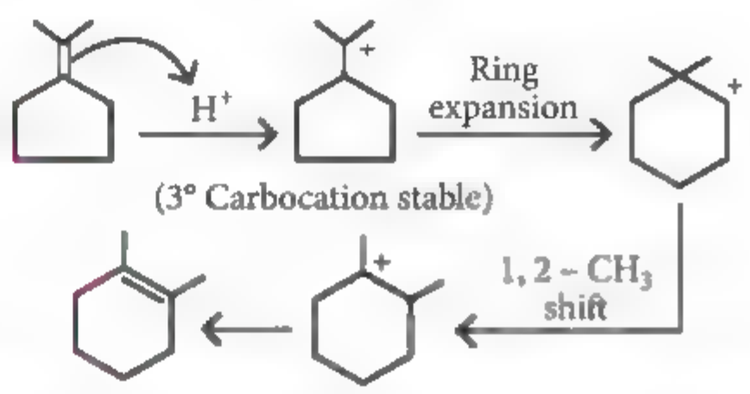
10. (b) : Since (*A*) imparts a golden yellow colour to the Bunsen flame, (*A*) is sodium.

$\underset{(A)}{Na} + H_2O \longrightarrow \underset{(C)}{NaOH} + \underset{(B)}{H_2}$

$\underset{(D)}{Zn} + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

$Zn + $ dil. $H_2SO_4 \longrightarrow ZnSO_4 + \underset{(B)}{H_2}$

11. (d) :



12. (a) : Normality of ferrous ammonium sulphate

$= \frac{3.92 \times 1000}{392 \times 100} = 0.1$

(Eq. wt. of Ferrous ammonium sulphate is 392.)

$N_1V_1 = N_2V_2$

$20 \times 0.1 = 18 \times N_2$

$N_2 = 0.111$

1 g equivalent of $KMnO_4$ = 31.6 g

0.111 g equivalent of $KMnO_4 = 31.6 \times 0.111 = 3.5$ g

13. (a) : $PbO_2 \longrightarrow PbO$

Change in O.S. is +4 to +2 hence reduction.

14. (b) : To precipitate AgCl,

$[Ag^+]$ required $= \frac{K_{sp}(AgCl)}{[Cl^-]} = \frac{1.0 \times 10^{-10}}{0.1} = 1.0 \times 10^{-9}$ M

$[Br^-]$ left $= \frac{K_{sp}(AgBr)}{[Ag^+]} = \frac{1.0 \times 10^{-13}}{1.0 \times 10^{-9}} = 1.0 \times 10^{-4}$ M

% of remaining $[Br^-] = \frac{1.0 \times 10^{-4}}{0.1} \times 100 = 0.1$

% of Br^- to be precipitated = 100 – 0.1 = 99.9

15. (d) : $Zn \longrightarrow Zn^{2+} + 2e^-$ ...(i)

$8e^- + 10H^+ + NO_3^- \longrightarrow NH_4^+ + 3H_2O$ ...(ii)

On applying operation, eq. (i) × 4 + eq. (ii) × 1

$4Zn + NO_3^- + 10H^+ \longrightarrow NH_4^+ + 3H_2O + 4Zn^{2+}$

Monthly Test Drive CLASS XI **ANSWER KEY**

1. (a)	**2.** (d)	**3.** (b)	**4.** (c)	**5.** (b)
6. (d)	**7.** (a)	**8.** (c)	**9.** (d)	**10.** (a)
11. (c)	**12.** (c)	**13.** (c)	**14.** (c)	**15.** (a)
16. (a)	**17.** (b)	**18.** (d)	**19.** (a)	**20.** (b, d)
21. (b,c,d)	**22.** (a,c,d)	**23.** (a,c)	**24.** (41.32)	**25.** (4.8)
26. (5.23)	**27.** (d)	**28.** (a)	**29.** (b)	**30.** (c)

BRUSH UP for NEET/JEE

CLASS-XI

Brush up your concepts to get high rank in NEET/JEE (Main and Advanced) by reading this column. This specially designed column is updated year after year by a panel of highly qualified teaching experts well-tuned to the requirements of these Entrance Tests.

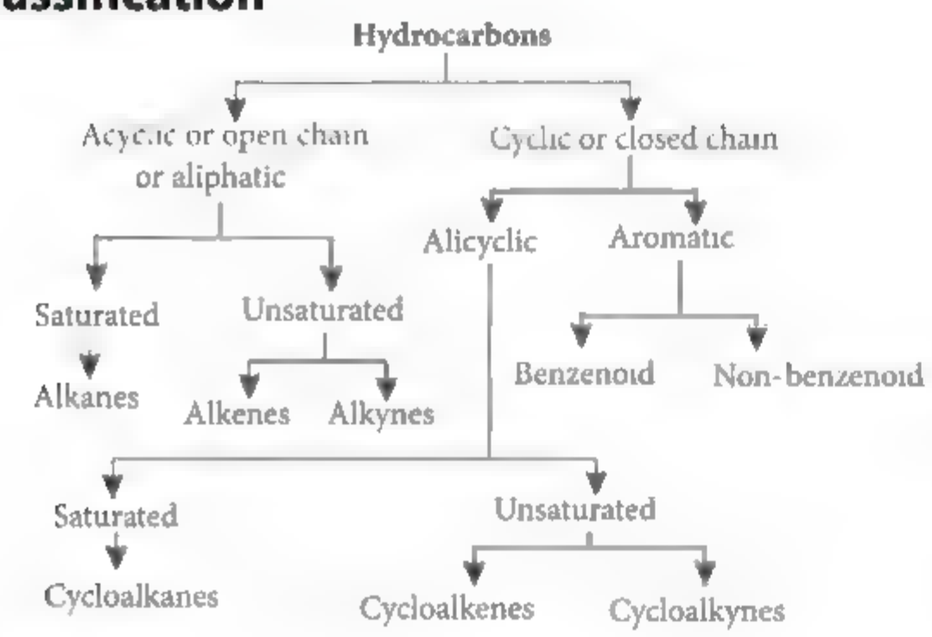
2020

Hydrocarbons / Environmental Chemistry

Hydrocarbons

- Organic compounds composed of only C and H are called hydrocarbons.

Classification

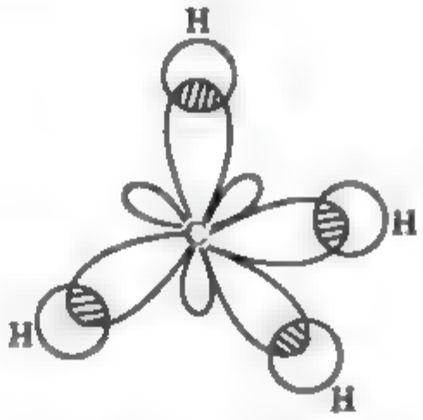


Alkanes

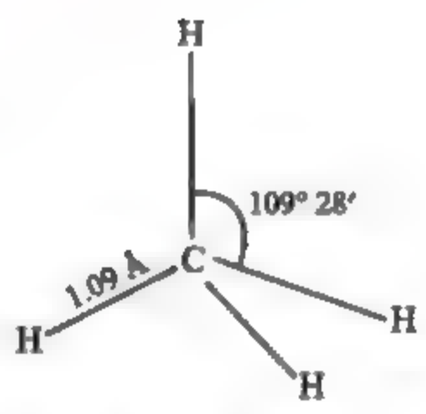
- Alkanes also called paraffins are saturated hydrocarbons with general formula C_nH_{2n+2}, where, n is equal to 1, 2, 3.... *e.g.*, CH_4 (methane), C_2H_6 (ethane), C_3H_8 (propane), etc.

Structure

- Each carbon atom of alkanes is in sp^3 state of hybridization with its four bonding orbitals directed towards the four corners of a regular tetrahedron.



Overlap of four sp^3 orbitals of carbon with the 1*s* orbital of four hydrogen atoms



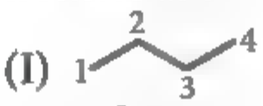
Bond length and bond angle in methane

Nomenclature

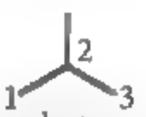
- Root word + ane = alkane
  e.g., $CH_3CH_2CH_2CH_3$ (n-butane), $CH_3CH_2CH_2CH_2CH_2CH_3$ (n-hexane)

Isomerism

- Alkanes exhibit mainly structural (chain) and conformational isomerism.
- **Structural isomerism :** Methane, ethane, propane do not exhibit isomerism. C_4H_{10} have two chain isomers as :

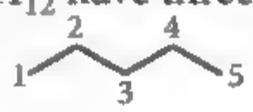
(I) 

Butane

(II) 

iso butane or 2-Methylpropane

C_5H_{12} have three chain isomers as :

(I) 

Pentane

(II) 
iso-pentane

(III) 
neo-pentane

Methods of Preparation

By hydrogenation of unsaturated hydrocarbons

$$CH_2{=}CH_2 + H_2 \xrightarrow[\text{or Pt or Pd}]{\text{Raney Ni}} CH_3{-}CH_3$$

Sabatier and Senderens reaction or reduction

$$CH_2{=}CH_2 + H_2 \xrightarrow[523\text{-}573\ K]{Ni} CH_3{-}CH_3$$

$$CH{\equiv}CH + 2H_2 \xrightarrow[523\text{-}573\ K]{Ni} CH_3{-}CH_3$$

Wurtz reaction

$$RX + 2Na + XR \xrightarrow{\text{Dry ether}} R{-}R + 2NaX$$

By hydroboration of alkenes

$$RCH{=}CH_2 \xrightarrow[\text{In diglyme}]{B_2H_6} (RCH_2CH_2)_3B \xrightarrow[NaOH]{AgNO_3} RCH_2CH_2CH_2CH_2R$$

Corey-House synthesis

$$RX + LiCuR'_2 \rightarrow RR' + R'Cu + LiX$$

Kolbe's electrolysis

$$2RCOONa + 2H_2O \xrightarrow{\text{Electrolysis}} R{-}R + 2CO_2 + 2NaOH + H_2$$

From Grignard's reagent

$$R{-}Mg{-}X + HOH \xrightarrow{H^+} R{-}H + Mg\begin{matrix}OH\\X\end{matrix}$$

Reduction of alkyl halides

$$R{-}X \xrightarrow{Zn/HCl} R{-}H + HX$$

Decarboxylation

$$RCOONa + NaOH \xrightarrow[CaO,\ 630\ K]{} R{-}H + Na_2CO_3$$

Chemical Properties

Halogenation

$$CH_4 + 4Cl_2 \xrightarrow[520\text{-}670\ K]{h\nu} CCl_4 + 4HCl$$

Nitration

$$R{-}H + \underset{\text{(Fuming)}}{HONO_2} \xrightarrow{673\ K} \underset{\text{Nitroalkane}}{R{-}NO_2} + H_2O$$

Sulphonation

$$R{-}H + HOSO_3H \xrightarrow[675\ K]{SO_3} RSO_3H + H_2O$$

Complete combustion

$$C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \rightarrow nCO_2 + (n+1)H_2O$$

Catalytic oxidation

$$\underset{(9\ :\ 1)}{2CH_4} + O_2 \xrightarrow[100\ atm/573\ K]{Cu\ tube} 2CH_3OH$$

Isomerisation

$$\underset{n\text{-Butane}}{CH_3(CH_2)_2CH_3} \xrightarrow[573\ K,\ 35\ atm]{AlCl_3\ +\ HCl\ (conc.)} \underset{\text{iso-butane}}{CH_3{-}\overset{\overset{CH_3}{|}}{CH}{-}CH_3}$$

Aromatisation

$$\underset{n\text{-Hexane}}{C_6H_{14}} \xrightarrow[773\ K/10\text{-}20\ atm]{Cr_2O_3/Al_2O_3} \underset{\text{Benzene}}{\text{⬡}} + 4H_2$$

Pyrolysis or cracking

$$C_6H_{14} \xrightarrow[6\text{-}7\ atm]{773\ K,} \begin{cases} C_6H_{12} + H_2 \\ C_4H_8 + C_2H_6 \\ C_3H_6 + C_2H_4 + CH_4 \end{cases}$$

$$C_{12}H_{26} \xrightarrow[973\ K]{Pt/Pd/Ni} C_7H_{16} + C_5H_{10} + \text{other products}$$

Conformations

- The different arrangements of atoms in space which result from the free rotation of groups about C—C single bond are called conformations or conformers or rotamers.
- **Conformations of Ethane (Sawhorse and Newman Projections)**
  - **Staggered conformation :** The hydrogen atoms attached to two carbons are far apart and experience minimum repulsion.
  - **Eclipsed conformation :** The hydrogen atoms attached to two carbons are as close together as possible and experience maximum repulsion.
  - **Gauche or Skew form :** A rotation of 60° converts a staggered conformation into an eclipsed conformation, or *vice-versa*. Rotation between 0° to 60° generates one of the many other arrangements in between staggered and eclipsed forms. These arrangements are called **gauche** or **skew form**.
  - **Order of stability :** Staggered > Skew or Gauche > Eclipsed

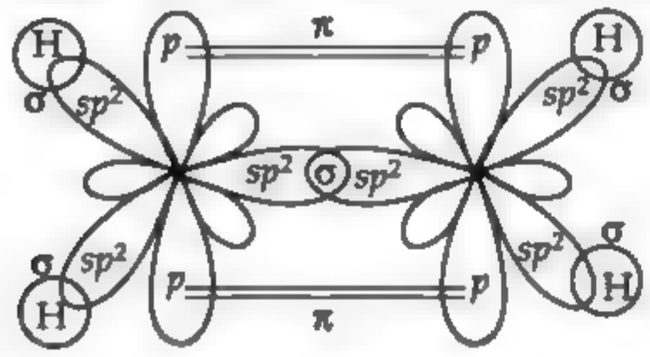
ALKENES

- Alkenes also called olefins are unsaturated hydrocarbons which have general formula 'C_nH_{2n}'. They contain double bond (C = C) which is considered as a functional group. *e.g.*, C_2H_4 (ethene or ethylene), C_3H_6 (propene or propylene).

Structure

- In ethylene molecule, one of the sp^2-hybridised orbitals of one carbon atom overlaps axially with one of the sp^2-orbitals of another carbon atom. Two

of the sp^2-hybridised orbitals of each carbon atom overlap separately and along the axes with the 1*s* orbitals of the hydrogen atoms. The pure *p*-orbital on each of the two carbon atoms overlap each other laterally (sideways) and thus, a new type of bond (π) is formed between the two carbon atoms.



Formation of ethylene molecule

Nomenclature

- Alkane – ane + ene = alkene

  e.g., $\overset{1}{C}H_2=\overset{2}{C}H-\overset{3}{C}H_2-\overset{4}{C}H_2-\overset{5}{C}H_3$

  Pent-1-ene (Pentene)

Isomerism

- Alkenes show following types of isomerism : Chain isomerism, position isomerism, ring chain isomerism and geometrical isomerism (*cis-trans* isomerism).

Methods of Preparation

- **Partial hydrogenation of alkynes :**

$$\underset{\text{Alkyne}}{R-C\equiv C-H}+H_2 \xrightarrow[\text{(Lindlar's catalyst)}]{Pd/CaCO_3+S} \underset{\text{cis-alkene}}{\overset{R}{\overset{H}{>}}C=C\overset{H}{\underset{H}{<}}}$$

- **Birch reduction :**

$$\underset{\text{Alkyne}}{R-C\equiv C-R} \xrightarrow{Na/Liq.\ NH_3} \underset{\text{trans-alkene}}{\overset{R}{\overset{H}{>}}C=C\overset{H}{\underset{R}{<}}}$$

- **By dehydrohalogenation of alkyl halides :**

$$-\overset{|}{\underset{H}{C}}-\overset{|}{\underset{X}{C}}- \xrightarrow[\Delta]{\text{alc. KOH}} >C=C< + HX$$

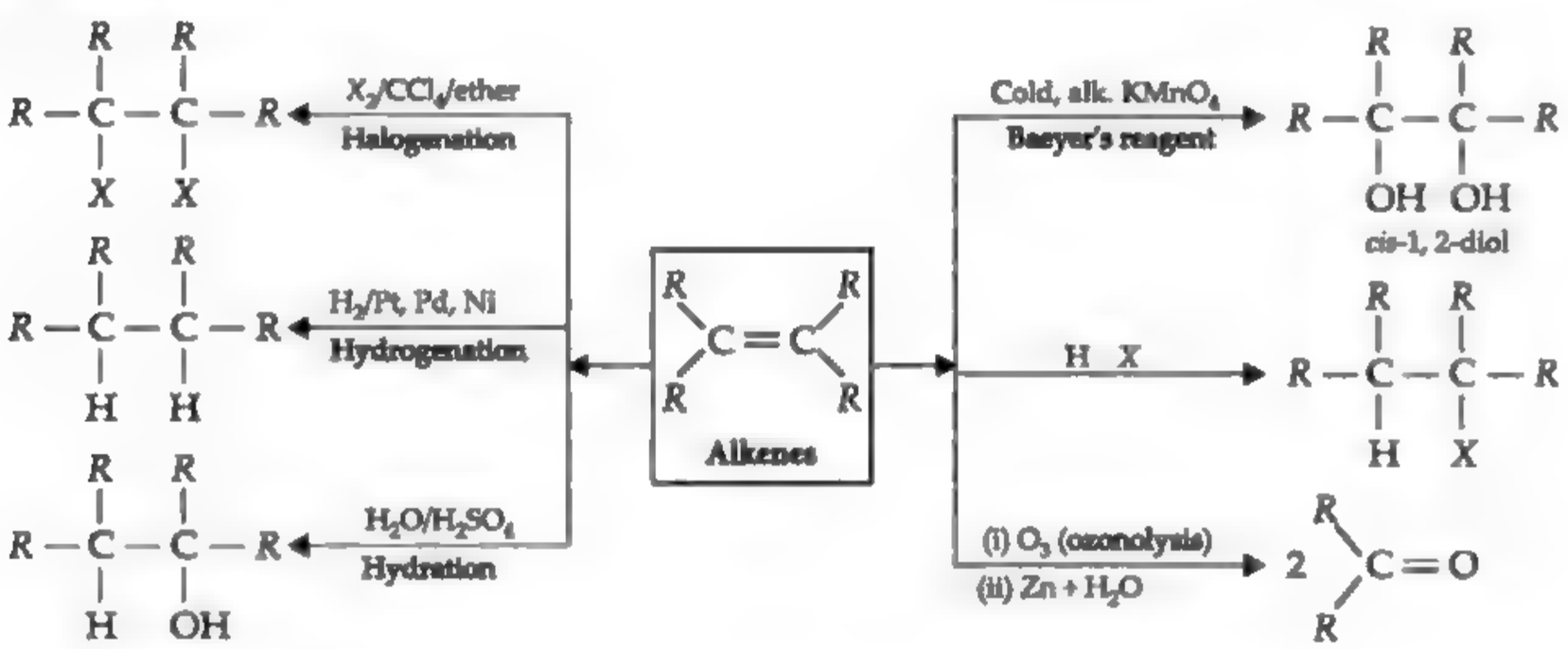
- **From vicinal dihalides :**

$$CH_2Br—CH_2Br + Zn \longrightarrow CH_2=CH_2 + ZnBr_2$$

$$CH_3CHBr—CH_2Br + Zn \longrightarrow CH_3CH=CH_2 + ZnBr_2$$

- **By dehydration of alcohols :**

$$-\overset{|}{\underset{H}{C}}-\overset{|}{\underset{OH}{C}}- \xrightarrow[\Delta]{95\%\ H_2SO_4} >C=C<$$



- **Markovnikov's and Anti-Markovnikov's rule :**

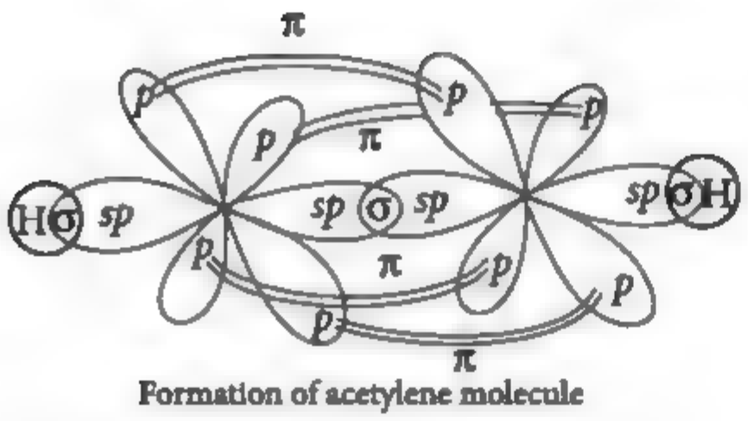
$$\underset{\text{(Anti-Markovnikov's addition)}}{\underset{\text{(Peroxide or Kharasch effect)}}{R-CH_2-CH_2-Br}} \xleftarrow[\text{Peroxide}]{H-Br} \underset{\text{Alkene}}{R-CH=CH_2} \xrightarrow{H-Br} \underset{\text{(Markovnikov's addition)}}{R-\underset{Br}{\underset{|}{CH}}-CH_3}$$

Alkynes

- Alkynes also called acetylenes are unsaturated hydrocarbons which have general formula C_nH_{2n-2}. They contain triple bond. *e.g.*, C_2H_2 (HC ≡ CH) called acetylene or ethyne and HC ≡ CCH_3 called propyne (or methyl acetylene).

Structure

- In acetylene molecule, one of the *sp*-hybridised orbitals of one carbon atom overlaps axially with one of the *sp*-hybridised orbitals of the other carbon atom; thus a C—C σ-bond is formed. Second *sp*-hybridised orbitals of each carbon atom overlaps axially and separately with the 1*s* orbitals of the two hydrogen atoms and thus two C—H σ-bonds are formed. The remaining two pure *p*-orbitals of one carbon atom overlaps sideways with the corresponding *p*-orbitals of the other carbon atom and thus, two C—C π-bonds are formed.



Formation of acetylene molecule

Nomenclature

- alkane – ane + yne = alkyne
  e.g., $CH_3-C\equiv C-CH_2-CH_2-CH_3$
  Hex-2-yne

Isomerism

- Ethyne does not show any type of isomerism. Alkynes form chain, position, functional and ring chain isomerism.

Methods of Preparation

Dehydrohalogenation of dihalides

$CH_2Br - CH_2Br \xrightarrow[NaNH_2,\ liq.\ NH_3]{alc.\ KOH,\ \Delta}$

By heating tetrahalides with Zn dust

$CHCl_2 - CHCl_2 + 2Zn \xrightarrow[\Delta]{Alcohol}$

By heating iodoform with silver

$CHI_3 + 6Ag + CHI_3 \longrightarrow$

ALKYNES

Kolbe's electrolysis

$\begin{matrix}CHCOO^-\\ ||\\ CHCOO^-\end{matrix} \xrightarrow{-2e^-}$

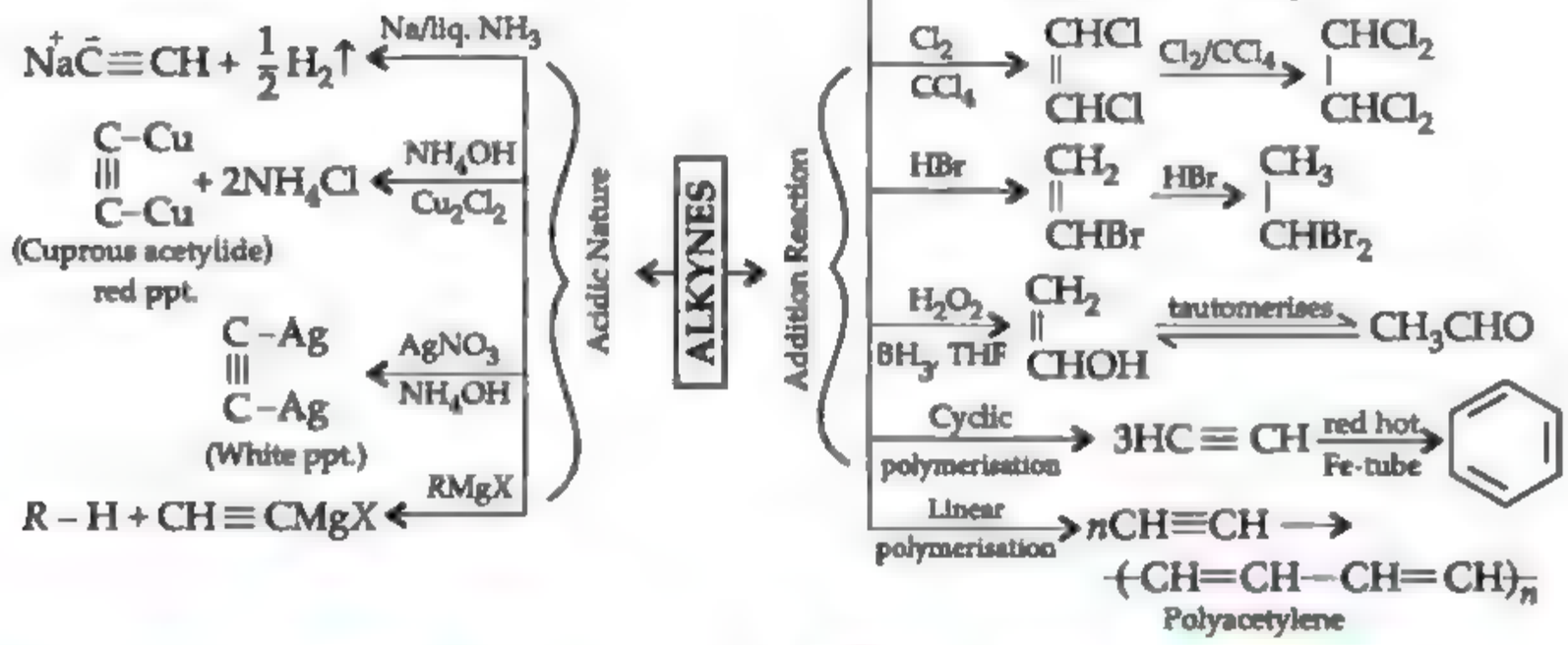
Laboratory method

$CaC_2 + 2H_2O \longrightarrow$
Calcium carbide

Berthelot synthesis

$2C + H_2 \xrightarrow[Electric\ arc,\ 3270\ K]{}$

Chemical Properties



$\overset{+}{Na}\overset{-}{C}\equiv CH + \frac{1}{2}H_2\uparrow$

$\begin{matrix}C-Cu\\ |||\\ C-Cu\end{matrix} + 2NH_4Cl$
(Cuprous acetylide)
red ppt.

$\begin{matrix}C-Ag\\ |||\\ C-Ag\end{matrix}$
(White ppt.)

$R-H + CH\equiv CMgX$

$CH_2=CH_2 \xrightarrow{H_2/Pd} CH_3-CH_3$

$CHCl=CHCl \xrightarrow{Cl_2/CCl_4} CHCl_2-CHCl_2$

$CH_2=CHBr \xrightarrow{HBr} CH_3-CHBr_2$

$CH_2=CHOH \xrightarrow{tautomerises} CH_3CHO$

$3HC\equiv CH \xrightarrow[Fe\text{-}tube]{red\ hot}$ benzene

$nCH\equiv CH \longrightarrow \underset{Polyacetylene}{-(CH=CH-CH=CH)_n-}$

Peep Into Previous Years

1. Which of the following reactions produce(s) propane as a major product?

(a) $H_3C-CH_2-CH_2-COONa \xrightarrow{NaOH,\ CaO,\ \Delta}$

(b) $H_3C-CH_2-CH_2-COONa + H_2O \xrightarrow{electrolysis}$

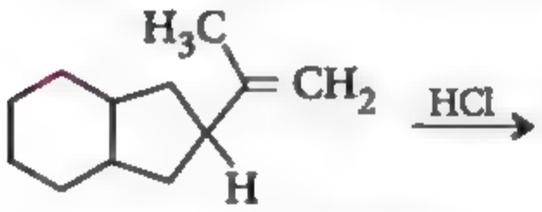
(c) $H_3C-CH_2-CH_2-Cl \xrightarrow{Zn,\ dil.\ HCl}$

(d) $H_3C-\underset{Br}{CH}-CH_2-Br \xrightarrow{Zn}$

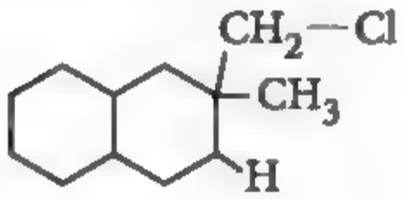
(JEE Advanced 2019)

COMIC CAPSULE

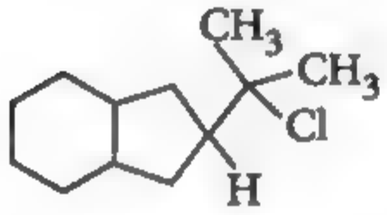
2. The major product of the following reaction is



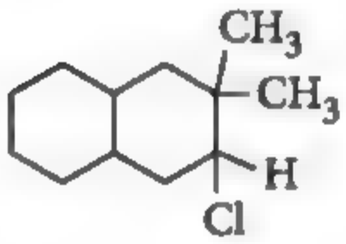
(a)



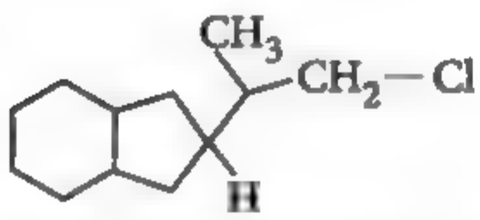
(b)



(c)

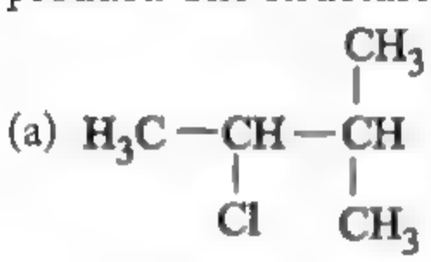


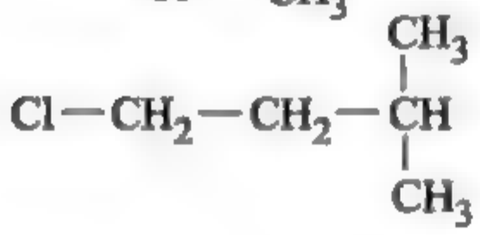
(d)

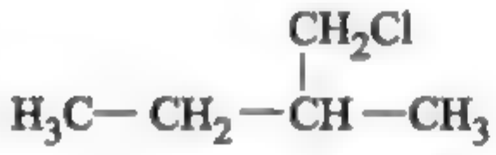


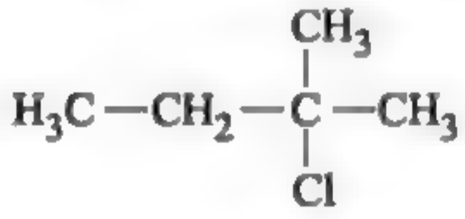
(JEE Main 2019)

3. An alkene *A* on reaction with O_3 and $Zn—H_2O$ gives propanone and ethanal in equimolar ratio. Addition of HCl to alkene *A* gives *B* as the major product. The structure of product *B* is

(a) 

(b) 

(c) 

(d) 

(NEET 2019)

4. Hydrocarbon (*A*) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (*A*) is

(a) $CH \equiv CH$ (b) $CH_2 = CH_2$

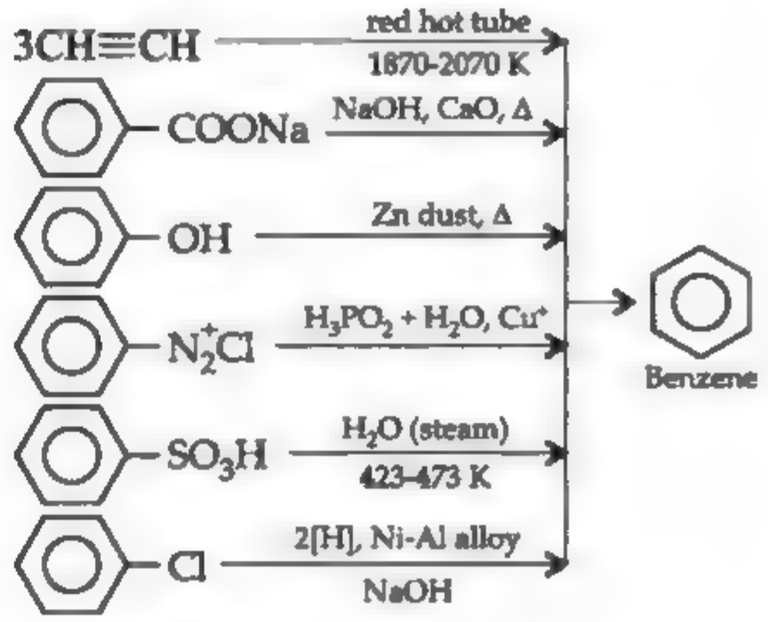
(c) $CH_3 — CH_3$ (d) CH_4

(NEET 2018)

Aromatic Hydrocarbons

- Hydrocarbons which contain one or more benzene rings either fused or isolated in their molecules are called aromatic hydrocarbons or arenes.

Methods of Preparation



Physical Properties

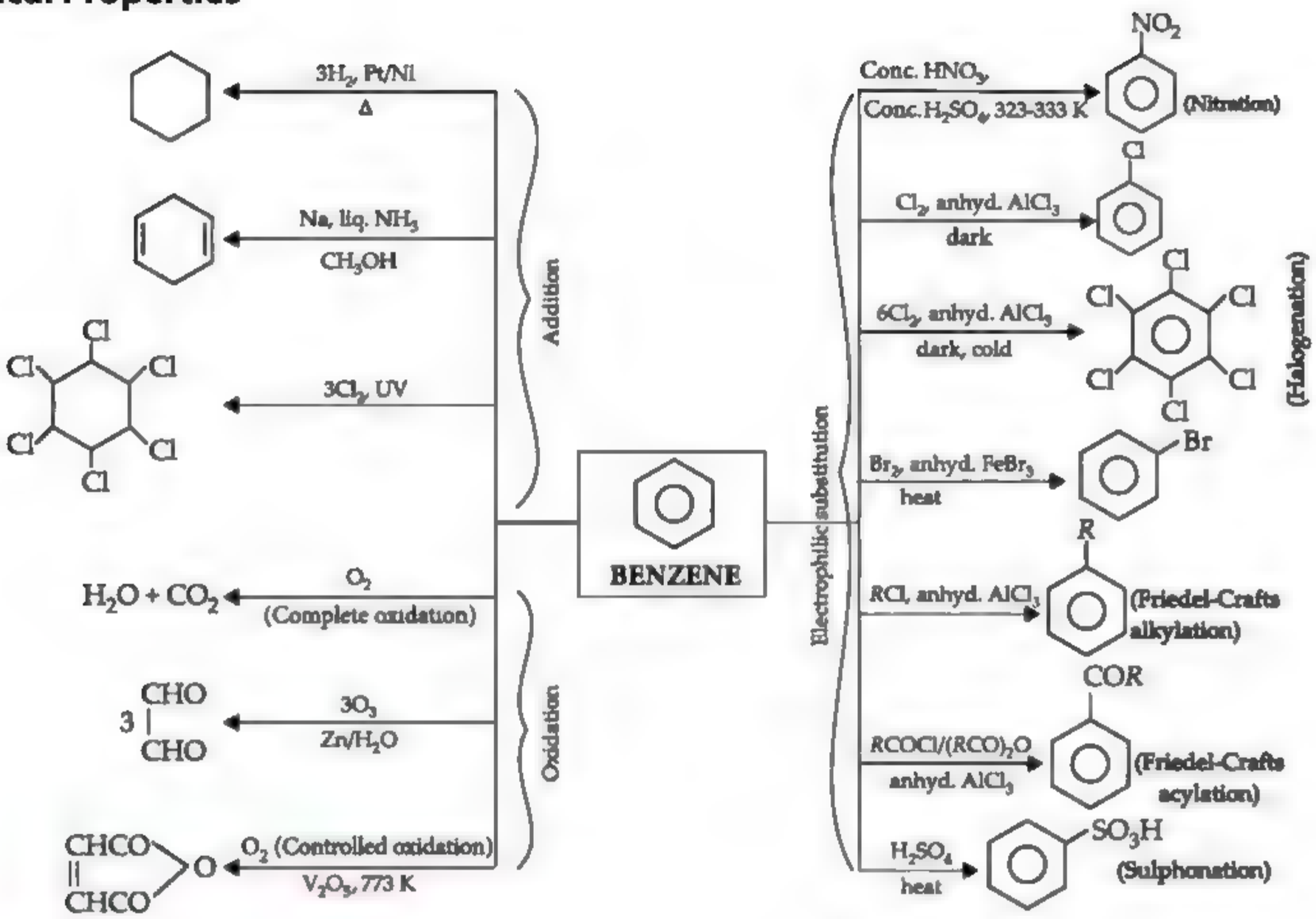
- Aromatic hydrocarbons are non-polar molecules.
- These are colourless liquids or solids with a characteristic aroma.
- These are immiscible with water but miscible in organic solvents and burn with sooty flame.

Huckel Rule of Aromaticity

- Huckel rule of aromaticity is applied to all the ring systems whether they have benzene ring or not and possess the following characteristics :
  - Planarity
  - Complete delocalisation of π-electrons in the ring.
  - Presence of $(4n + 2)\pi$-electrons in the ring where $n = 0, 1, 2, 3, \ldots$ etc. *e.g.*,

- **Aromatic :**
  - Cyclic, planar molecule
  - Complete delocalisation of π electrons
  - Follow Huckel rule $(4n + 2)\ \pi\ e^-$s
- **Anti-aromatic :**
  - Cyclic, planar molecule
  - Complete delocalisation of π electrons
  - Follow $4n\ \pi\ e^-$s
- **Non-aromatic :**
  - Either non-cyclic, non-planar
  - No delocalisation of π electrons.
  - May or may not follow Huckel rule.

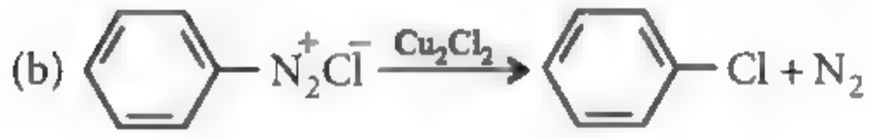
Chemical Properties

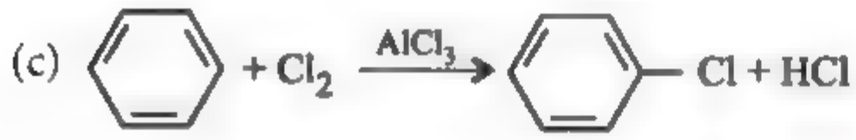


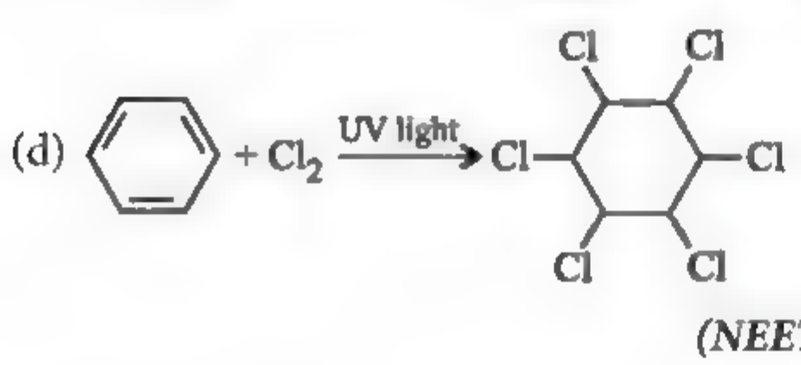
Peep Into Previous Years

5. Among the following the reaction that proceeds through an electrophilic substitution is

(a) 

(b) 

(c) 

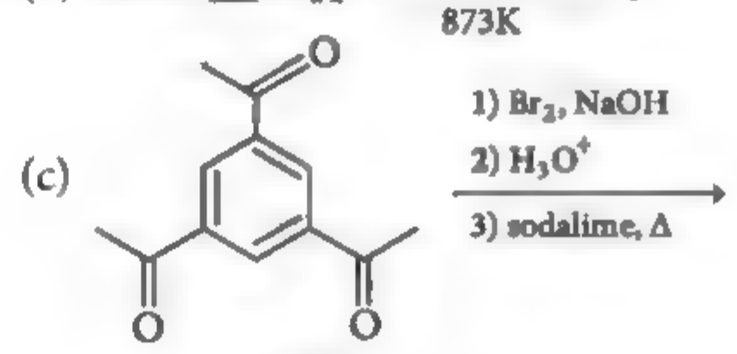
(d) 

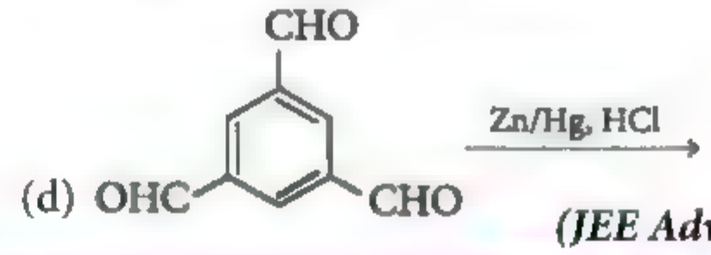
(NEET 2019)

6. The reaction(s) leading to the formation of 1,3,5-trimethylbenzene is (are)

(a) 

(b) 

(c) 

(d) 

(JEE Advanced 2018)

Points For Extra Scoring

- The number of degree of unsaturation in a hydrocarbon is given by : $\frac{2n_4 + 2 - n_2}{2}$.
- Addition of symmetrical reagents over symmetrical alkenes can be generalised as
  - *cis*-alkene + syn addition ⟶ meso product
  - *trans*-alkene + syn addition ⟶ racemic product
  - *cis*-alkene + anti addition ⟶ racemic product
  - *trans*-alkene + anti addition ⟶ meso product.

Environmental Chemistry

- Environmental chemistry deals with the study of the origin, transport, reactions, effects and fates of chemical species in the environment.

Environmental Pollution

- Any undesirable change in the surrounding which has harmful effects on living beings is called environmental pollution. A substance which causes pollution, is known as pollutant.
- **Primary and secondary pollutants :** Primary pollutants are those which remain as such in the environment after their formation like NO, SO_2, NO_2 whereas secondary pollutants are formed from the primary pollutants like PAN (Peroxyacetyl nitrate).

Air Pollution

- It is the addition of undesirable materials into the atmosphere either due to natural phenomena or due to human activity on the earth which adversely affect the quality of the air and hence, affects the life on the earth.

Greenhouse Effect and Global Warming

- The retention of heat by the earth and atmosphere from the sun and its prevention to escape into the outer space is known as greenhouse effect.
  - Greenhouse gases such as CO_2, ozone, methane, chlorofluorocarbon compounds and water vapour form a thick cover around the earth which prevents the IR rays emitted by the earth to escape.
  - It gradually leads to increase in temperature of atmosphere. This phenomenon of increasing earth's temperature is called global warming.

Acid Rain

- Rain water normally has a pH of 5.6 due to dissolution of CO_2 present in the atmosphere.
  $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$
- When this pH falls below 5.6, the rain water becomes acidic. The main gases responsible for acid rain are SO_2 and NO_2.
- **Harmful Effects of Acid Rain**
  - Damage to buildings and statues made of marble, limestone, slate, etc.
  - It is toxic to vegetation and aquatic life.
  - It corrodes water pipes resulting in the leaching of the heavy metals such as Fe, Pb and Cu into the drinking water which have toxic effects.

Smog

- The word smog is derived from smoke and fog. It is the major air pollutant.

$$\text{Smoke} + \underset{\text{(containing harmful gases)}}{\text{Fog}} \longrightarrow \text{Smog}$$

Classical smog	Photochemical smog
Also called as London smog.	Also called as Los Angeles smog.
Formed due to oxides of sulphur.	Formed due to oxides of nitrogen.
Contains primary pollutants.	Contains secondary pollutants.
It is reducing in nature.	It is oxidising in nature.

Stratospheric Pollution (Ozone depletion)

- Ozone (O_3) present in the stratosphere prevents about 99.5% of UV radiations from reaching the earth's surface and thereby protecting humans and other animals from its harmful effects.
- A dynamic equilibrium exists between the production and decomposition of ozone molecules.
  $O_{2(g)} \xrightarrow{UV} O_{(g)} + O_{(g)}$; $O_{(g)} + O_{2(g)} \underset{}{\overset{UV}{\rightleftharpoons}} O_{3(g)}$
- The main reason of ozone layer depletion is the release of chlorofluorocarbon compounds (CFCs), also known as freons.

Water Pollution

- Water pollution may be defined as any change in its physical, chemical or biological properties or contamination with foreign materials that can adversely affect human beings or reduce its utility for the intended use.

Effects of Water Pollution

- High concentrations of fluoride are poisonous and are harmful to bones and teeth at levels over 10 ppm.
- Excess nitrate in drinking water can lead to blue baby syndrome.
- Excess sulphate (> 500 ppm) have a laxative effect.

Biochemical Oxygen Demand (BOD)

- The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water is called BOD. It is a measure of the amount of organic material in the water.

Chemical Oxygen Demand (COD)

- It is the measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals.

Eutrophication

- The process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as eutrophication.

Soil Pollution

- Soil pollution is the addition of such chemical substances (in an indefinite proportion) which deteriorates the quality, texture and mineral content of the soil and disturbs the biological balance of the organisms in it and has lethal effect on the plant growth.
- Some major soil pollutants and their sources are :

Pollutants	Major sources
Industrial wastes	Waste products from paper, sugar, chemical industries dumped into the soil.
Agricultural wastes	Chemicals such as fertilizers, pesticides, etc. used for killing insects, fungi and weeds.
Radioactive pollutants	Dumping of nuclear wastes into the soil.

Control of Environmental Pollution

- **Waste management :** Environmental pollution can be controlled to a certain extent by managing the waste disposal in a proper way.
- **Recycling :** A large amount of disposed waste material can be reused by recycling the waste. Thus, it reduces the land fill and converts waste into usable forms.
- **Sewage treatment :** It can be done by :
  - Incineration
  - Digestion
  - Dumping

Green Chemistry

- Green chemistry is a process that would bring about minimum pollution or deterioration to the environment.
- It is a chemical philosophy encouraging the design of products and processes that reduces or eliminates the use and generation of hazardous substances.
- Green chemistry in day-to-day life :
  - Dry cleaning of clothes
  - Bleaching of paper
  - To clean turbid water

Peep Into Previous Years

7. The compound that is not a common component of photochemical smog is

(a) $H_3C-\underset{\underset{O}{\|}}{C}-OONO_2$

(b) $CH_2=CHCHO$

(c) CF_2Cl_2 (d) O_3 ***(JEE Main 2019)***

8. Among the following, the one that is not a greenhouse gas is

(a) sulphur dioxide (b) nitrous oxide
(c) methane (d) ozone. ***(NEET 2019)***

9. Water filled in two glasses *A* and *B* have BOD values of 10 and 20, respectively. The correct statement regarding them, is

(a) *A* is suitable for drinking, whereas *B* is not
(b) *A* is more polluted than *B*
(c) both *A* and *B* are suitable for drinking
(d) *B* is more polluted than *A*. ***(JEE Main 2019)***

10. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity?

(a) N_2O_5 (b) NO_2
(c) N_2O (d) NO ***(NEET 2018)***

Points For Extra Scoring

- The carboxyhaemoglobin is about 300 times more stable than the oxyhaemoglobin complex.
- Clean water has a BOD value of less than 5 ppm whereas highly polluted river water may have BOD value of 17 ppm or more.
- pH of drinking water should be between 5.5 and 9.5.
- Excess nitrate in drinking water lead to methemoglobinemia (blue-baby syndrome).
- **International standards for drinking water :** Fluorides < 1 ppm, Lead < 50 ppb, Sulphates < 500 ppm, Nitrates < 50 ppm.

Answer Key For Peep Into Previous Years

1.	(a, c)	2.	(b)	3.	(d)	4.	(d)	5.	(c)	6.	(a, b, d)
7.	(c)	8.	(a)	9.	(d)	10.	(a)				

WRAP it up!

1. For the following reaction,

$$A \xleftarrow[150\,^\circ C]{NaNH_2} CH_3(CH_2)_2CCl_2CH_3 \xrightarrow[Fused]{KOH,\ 200\,^\circ C} B$$

products '*A*' and '*B*' are

(a) same, $CH_3CH_2-C\equiv C-CH_3$

(b) *A* : $CH_3-CH_2-C\equiv C-CH_3$

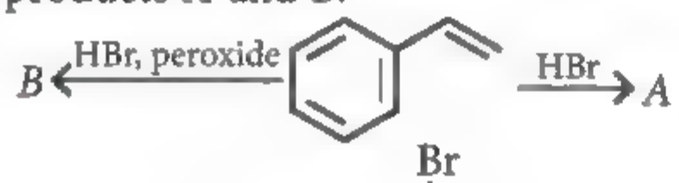
B : $CH_3-CH_2-CH_2-C\equiv CH$

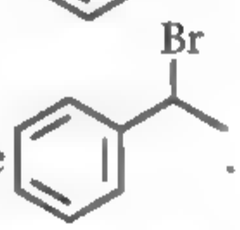
(c) same, $CH_3-CH_2-CH_2-C\equiv CH$

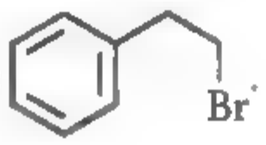
(d) *A* : $CH_3-CH_2-CH_2-C\equiv CH$

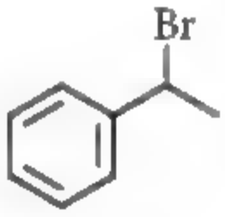
B : $CH_3-CH_2-C\equiv C-CH_3$

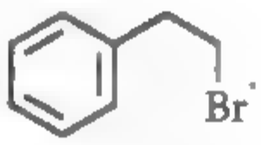
2. Observe the following reactions and predict the major products *A* and *B*.

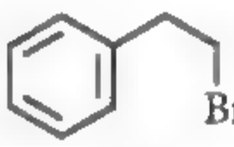


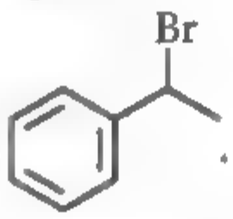
(a) *A* and *B* both are 

(b) *A* and *B* both are 

(c) *A* is 

and *B* is 

(d) *A* is 

and *B* is 

3. The product obtained *via* oxymercuration ($HgSO_4$+ H_2SO_4) of 1-butyne would be

(a) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

(b) $CH_3-CH_2-CH_2-CHO$

(c) $CH_3-CH_2-CHO + HCHO$

(d) $CH_3CH_2COOH + HCOOH$

4. Carbon monoxide is naturally produced by oxidation of __X__, a gas present in swamp area while it can be produced by __Y__ of fuels containing carbon.

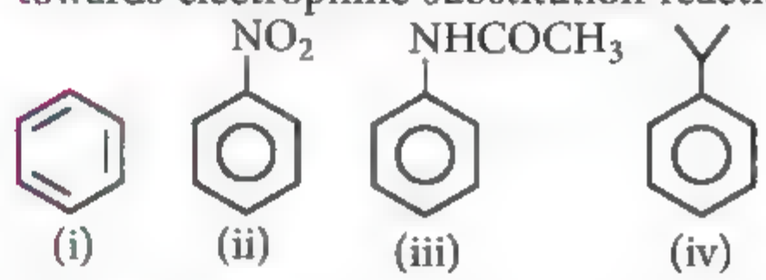
(a) $X = CO_2$, Y = complete combustion

(b) $X = CH_4$, Y = incomplete combustion

(c) X = C, Y = oxidation

(d) $X = CH_4$, Y = complete combustion

5. The correct order for the following compounds towards electrophilic substitution reaction is



(a) (iv) > (iii) > (ii) > (i) (b) (i) > (ii) > (iii) > (iv)

(c) (iv) > (iii) > (i) > (ii) (d) (iii) > (iv) > (i) > (ii)

6. Consider the reaction,

$$RH + (CH_3)_3COCl \xrightarrow{Heat}$$

The expected major products are

(a) $(CH_3)_3COH$ and *R*Cl

(b) *R*OCl and $(CH_3)_3CH$

(c) *R*OH and $(CH_3)_3CCl$

(d) $(CH_3)_3COR$ and HCl

7. A body which allows the short wavelength incoming solar radiations to enter in but does not allow long wavelength outgoing IR radiations to escape out is called

(a) global warming (b) greenhouse

(c) ionosphere (d) stratosphere.

8. Which of the following is the best sequence to convert benzene into 3-chloroaniline?

(a) Nitration, chlorination, reduction

(b) Nitration, reduction, chlorination

(c) Nitration, chlorination, sulphonation

(d) Chlorination, nitration, reduction

9. Eutrophication is due to

(a) SO_4^{2-} ions present in water

(b) NaCl present in water

(c) PO_4^{3-} ions present in water

(d) heavy metals present in water.

10. An alkane with mol. mass = 86 on bromination gives only two monobromo derivatives (excluding stereoisomers). The alkane is

(a) $(CH_3)_2CHCH_2CH_2CH_3$

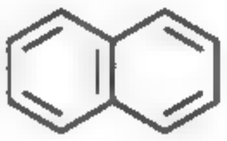
(b) $(CH_3)_3C-CH_2CH_3$

(c) $(CH_3)_2CH-CH(CH_3)_2$

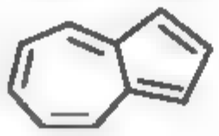
(d) $(CH_3)_4C$

11. Which of the following chemical systems is/are non-aromatic?

I. 

II. 

III. 

IV. 

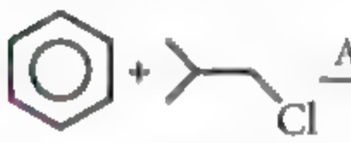
(a) Only III (b) Only IV
(c) Only II and IV (d) None of these

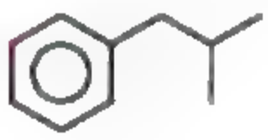
12. B.O.D values of four samples of water *A*, *B*, *C* and *D* are given below :

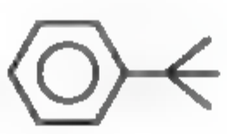
A. 160 ppm B. 35 ppm
C. 180 ppm D. 25 ppm

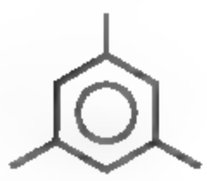
The decreasing order of extent of pollution in water is

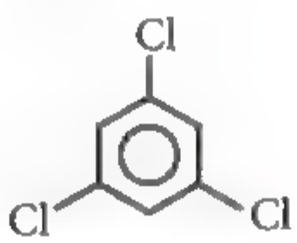
(a) $C > A > D > B$ (b) $D > B > A > C$
(c) $C > A > B > D$ (d) $D > A > B > C$

13.  *X*, compound *X* is

(a) 

(b) 

(c) 

(d) 

14. Which of the following is not an example of green chemistry?

(a) Catalytic dehydrogenation of the diethanolamine without using cyanide and formaldehyde.
(b) Replacement of CFCs by CO_2 as blowing agent in the manufacture of polystyrene foam sheets.
(c) Reacting methylamine and phosgene to produce methyl isocyanate
(d) Replacement of organotins by 'sea-nine' as antifouling compound in sea marines.

15. Which of the following reagents cannot be used to distinguish between propene and propyne?

(a) Grignard reagent
(b) Ammoniacal $AgNO_3$
(c) Lucas reagent
(d) Ammoniacal Cu_2Cl_2

16. Which of the following statements is false?

(a) Over Antarctica, the depletion of ozone layer is due to the formation of chlorine nitrate.
(b) Both O_3 and NO_2 reacts with unburnt hydrocarbons in the polluted air to give PAN.
(c) Classical smog consists of a mixture of smog, fog and sulphur dioxide.
(d) Gaseous pollutants consist of oxide of carbon, sulphur and nitrogen along with dust, fumes, smoke, smog, etc.

17. In the following sequence of reactions, the compound *B* is

$$CH_3CH{=}CHCH_3 \xrightarrow{O_3} A \xrightarrow[Zn]{H_2O} B$$

(a) CH_3CHO (b) CH_3CH_2CHO
(c) CH_3COCH_3 (d) $CH_3CH_2COCH_3$

18. The chemicals and the reaction conditions required for the preparation of ethane are

(a) C_2H_5I, Zn — Cu, C_2H_5OH
(b) CH_3Cl, Na, H_2O
(c) KOOC — CH = CH — COOK, electrolysis
(d) CH_3COONa, NaOH, CaO, Δ

19. The total number of alkenes possible by dehydrobromination of 3-bromo-3-cyclopentylhexane using alcoholic KOH is

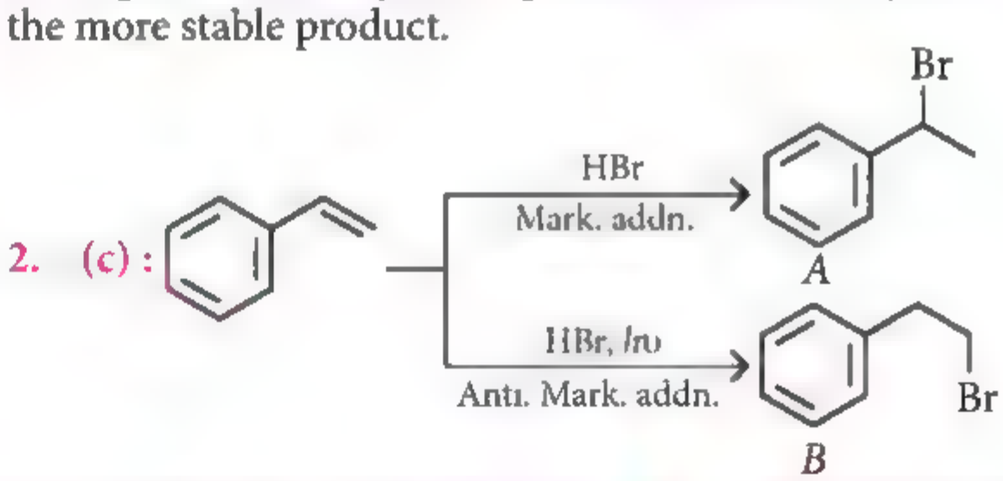
(a) 5 (b) 4 (c) 3 (d) 2

20. Identify the incorrect statement among the following.

(a) Oxides of nitrogen in the atmosphere can cause the depletion of ozone layer.
(b) Ozone absorbs the intense ultraviolet radiations of the sun.
(c) Depletion of ozone layer is because of its chemical reactions with chlorofluorocarbons
(d) Ozone absorbs infrared radiations.

SOLUTIONS

1. (d): $NaNH_2$ is a strong base, that gives kinetic product, terminal alkyne as the major product while KOH gives thermodynamic product internal alkyne, as the more stable product.

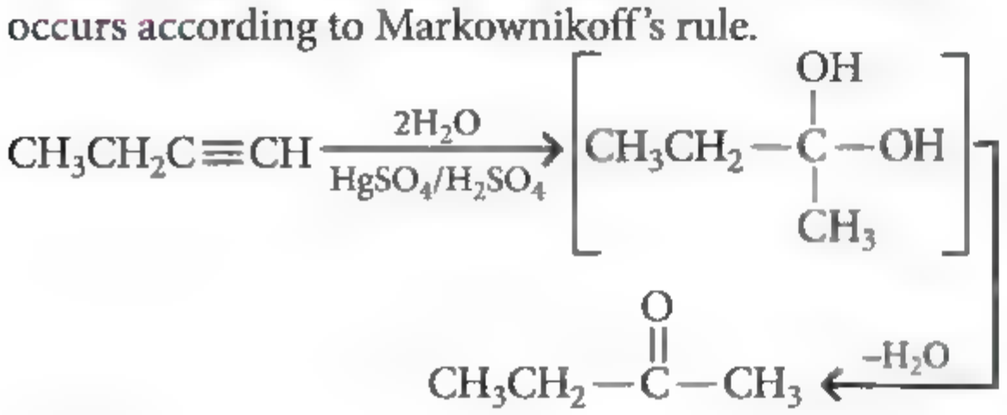
2. (c) : 

UNSCRAMBLED WORDS

JANUARY 2020

1-g- ADIPOCERE	2-a- AMANITINS
3-e-BIXIN	4-h- CARCEPLEXES
5-d- TRIFLATE	6-f- TETRAZOLES
7-b- SUBERANE	8-c- KRILIUM

3. (a) : Hydration of alkynes *via* oxymercuration occurs according to Markownikoff's rule.



4. (b)

5. (d) : $-NHCOCH_3$ is more activating than isopropyl group. Therefore, option (d) is correct.

6. (a) : Alkanes are monochlorinated with *t*-butyl hypochlorite, *t*-BuOCl.

Initiation : Homolysis of *t*-butyl hypochlorite.

$$t\text{-BuO}\overset{\curvearrowright}{-}\overset{\curvearrowright}{\text{Cl}} \longrightarrow t\text{-BuO}^{\bullet} + \text{Cl}^{\bullet}$$

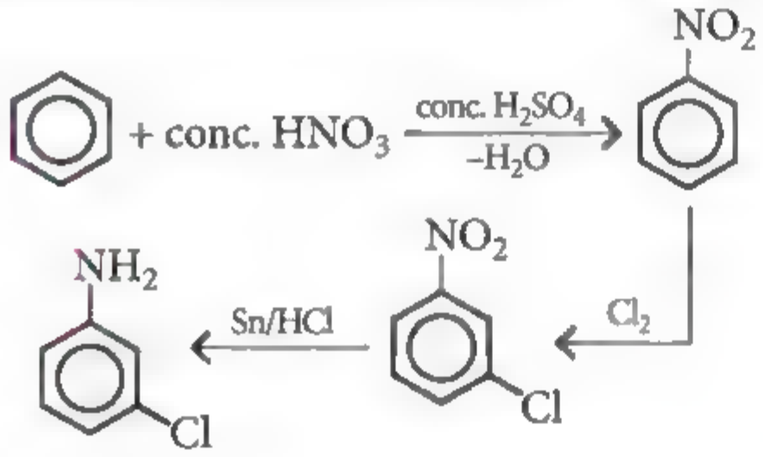
Propagation :

(a) $t\text{-BuO}^{\bullet} + R\text{—H} \longrightarrow t\text{-BuOH} + R^{\bullet}$

(b) $R^{\bullet} + t\text{-BuOCl} \longrightarrow RCl + t\text{-BuO}^{\bullet}$

7. (b) : A greenhouse allows the short wavelength incoming solar radiations to enter in but does not allow long wavelength outgoing IR radiations to escape out.

8. (a) :



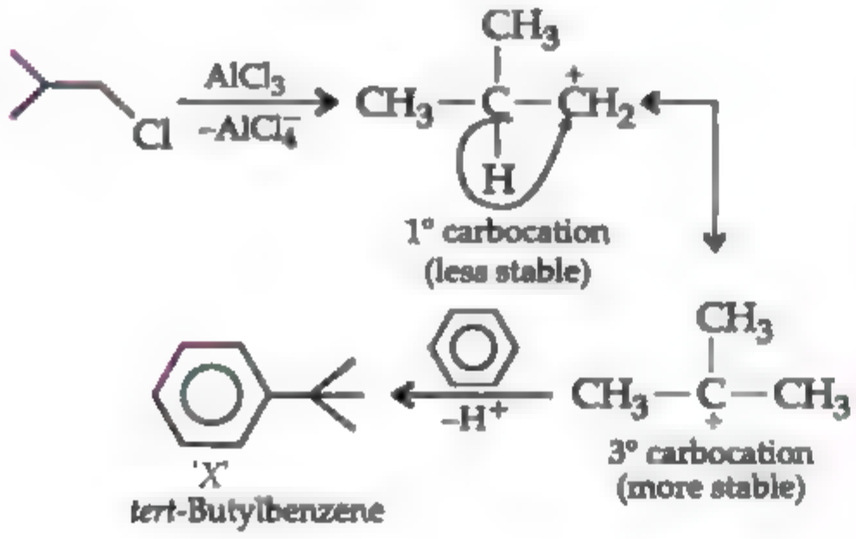
9. (c)

10. (c) : The alkane with mol. mass 86 is hexane (C_6H_{14}), 2,3-dimethylbutane, *i.e.*, option (c) has only two types of hydrogens and hence forms two monobromo derivatives.

11. (a) : All the species except III are planar and possess $(4n + 2)$ π electrons which are completely delocalized.

12. (c)

13. (b) :

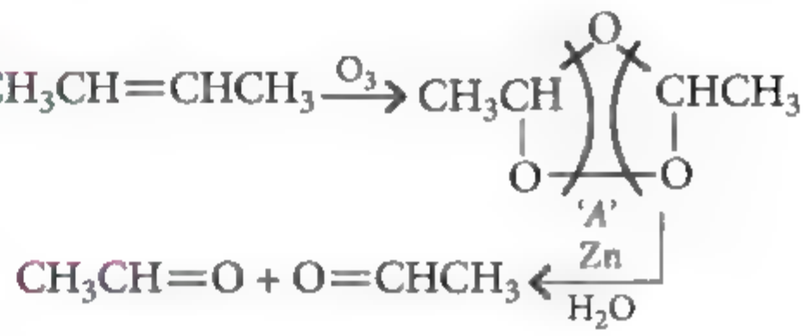


14. (c)

15. (c) : Propyne has acidic hydrogen but propene does not. Therefore, propyne reacts with Grignard reagent to evolve alkane (*R*H), with $AgNO_3$ to give white ppt. of silver propynide and with ammoniacal solution of Cu_2Cl_2 to form red ppt. of copper propynide.

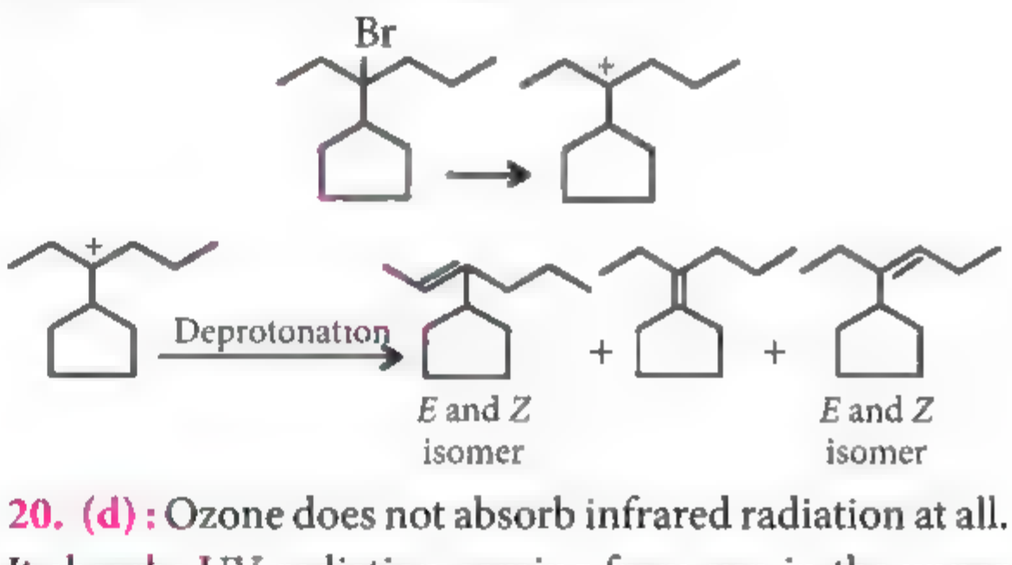
16. (d)

17. (a) :



18. (a) : $C_2H_5I + 2H \xrightarrow[\text{Reduction}]{Zn - Cu,\ C_2H_5OH} C_2H_6 + HI$

19. (a) : Total no. of alkenes will be = 5



20. (d) : Ozone does not absorb infrared radiation at all. It absorbs UV radiation coming from sun in the upper atmosphere and acts as a umbrella thus protecting human being living on earth.

EXAM CORNER 2020

Exam	Date
WB JEE	2nd February
JEE Main II	05th, 07th to 09th & 11th April
VITEEE	13th to 19th April
SRMJEEE	12th to 20th April
J & K CET	19th April
Kerala PET	20th & 21st April
Karnataka CET	22nd & 23rd April
NEET	3rd May
COMEDK (Engg.)	10th May
AMU (Engg.)	10th May
BITSAT	16th to 25th May
MHT CET	16th to 20th May
JEE Advanced	17th May

CBSE warm-up!

CLASS-XI

Practice questions for CBSE Exams as per the latest pattern and marking scheme issued by CBSE for the academic session 2019-20.

Practice Paper 2020

Time Allowed : 3 hours
Maximum Marks : 70

GENERAL INSTRUCTIONS

(i) All questions are compulsory.
(ii) Section A: Q.no. 1 to 20 are very short answer questions (objective type) and carry 1 mark each.
(iii) Section B: Q.no. 21 to 27 are short answer questions and carry 2 marks each.
(iv) Section C: Q.no. 28 to 34 are long answer questions and carry 3 marks each.
(v) Section D: Q.no. 35 to 37 are also long answer questions and carry 5 marks each.
(vi) There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
(vii) Use log tables if necessary, use of calculators is not allowed.

SECTION - A

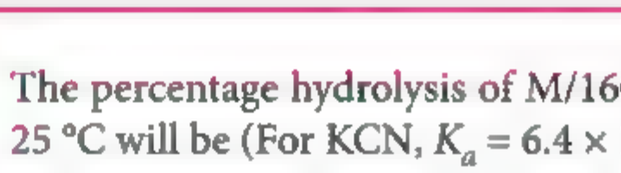
Read the given passage and answer the questions 1 to 5 that follow :

When an acid reacts with a base to form salt and water, the process is called neutralisation. The indicator used in the titration depends upon the nature of the acid and the nature of the base. The reverse of neutralisation is salt hydrolysis. The salt of a weak acid or a weak base does not hydrolyse completely. The extent of hydrolysis is expressed in terms of 'degree of hydrolysis'. As it is an equilibrium process, the equilibrium constant is called hydrolysis constant (K_h). Knowing the ionisation constants of the weak acid and weak base involved, the pH of the salt solution can be calculated for any particular concentration.

1. Identify the indicator used to titrate Na_2CO_3 solution with HCl.
2. Why are strong acids generally used as standard solutions in acid-base titrations?
3. The percentage hydrolysis of M/160 KCN solution at 25 °C will be (For KCN, $K_a = 6.4 \times 10^{-10}$)
4. The pH of 1 M ammonium acetate solution will be (Given pK_a of acetic acid = 4.76 and pK_b of NH_4OH = 4.75)
5. The solubility product of silver chloride is 1.8×10^{-10} at 298 K. The solubility of AgCl in 0.01 M HCl solution in mol/dm^3 is

Questions 6 to 10 are one word answers :

6. Which quantum number tells us about the shapes of sub-shells?
7. Write the IUPAC name for the element with atomic number 106.
8. What is the binding force between gas molecule under ordinary conditions of temperature and pressure?
9. Write IUPAC name of the organic compound :



10. Name the amorphous form of silica.

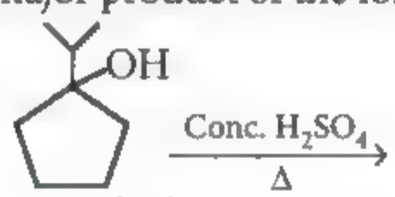
Questions 11 to 15 are multiple choice questions :

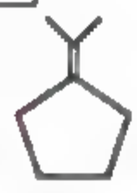
11. In Lassaigne's test for sulphur in the organic compound with sodium nitroprusside solution the purple colour formed is due to
    (a) $Na_4[Fe(CN)_5(NOS)]$ (b) $Na_3[Fe(CN)_5S]$
    (c) $Na_3[Fe(CN)_5(NOS)]$ (d) $Na_3[Fe(CN)_6]$

12. 200 g of hydrogen reacts with nitrogen according to equation, $3H_{2(g)} + N_{2(g)} \rightarrow 2NH_{3(g)}$, to produce
    (a) 11.322 g of ammonia (b) 113.22 g of ammonia
    (c) 1133.33 g of ammonia (d) 11322 g of ammonia.

13. For the species NO, NO^+ and NO^-, the correct order of bond lengths is
    (a) $NO^+ < NO < NO^-$
    (b) $NO^+ < NO^- < NO$
    (c) $NO < NO^- < NO^+$
    (d) $NO < NO^+ < NO^-$

14. What is the major product of the following reaction?



(a)  (b)  (c)  (d) 

15. Which of the following alkali metals gives hydrated salts?
    (a) Li (b) Na (c) K (d) Cs

Questions 16 to 20 :

(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(c) Assertion is correct, but reason is wrong statement.
(d) Assertion is wrong, but reason is correct statement.

16. **Assertion :** Heat added to a system at lower temperature causes greater randomness than when the same quantity of heat is added to it at higher temperature.
    Reason : Entropy is a measure of the degree of randomness or disorder in the system.

17. **Assertion :** In the H-atom, the electronic transition $n_3 \rightarrow n_2$ will emit greater energy than the electronic transition $n_4 \rightarrow n_3$.
    Reason : The difference between the energies of the adjacent energy levels decreases as we move outward from the nucleus.

18. **Assertion :** $KClO_3$ is a strong oxidising agent.
    Reason : Decomposition of $KClO_3$ will give KCl and O_2 as products.

19. **Assertion :** For greenhouse effect, presence of green plants is essential.
    Reason : CO_2 and water vapour present in the atmosphere absorb the re-emitted I.R. radiations from the earth's surface and warm the air.

20. **Assertion :** Melting and boiling points of D_2O are higher than those of ordinary H_2O.
    Reason : D_2O has lesser degree of association and lower molecular mass than H_2O.

SECTION - B

21. Calcium carbonate reacts with aqueous HCl to give $CaCl_2$ and CO_2 according to the reaction :
    $CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$
    What mass of $CaCO_3$ is required to react completely with 25 mL of 0.75 M HCl?
    (At. wt. of Ca = 40, C = 12, O = 16, Cl = 35.5 u)
    (NCT 2010, 2012, 2013)

22. The longest wavelength doublet absorption transition is observed at 589 and 589.6 nm. Calculate the frequency of each transition and energy difference between two excited states.

23. Give the name and atomic number of the inert gas in which the total number of *d*-electrons is equal to the difference in numbers of total *p* and *s*-electrons.

    OR

    A, *B*, *C*, *D* and *E* have the following electronic configuration :
    $A : 1s^2, 2s^2, 2p^1$
    $B : 1s^2, 2s^2, 2p^6, 3s^2, 3p^1$
    $C : 1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
    $D : 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
    $E : 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
    Which among these belong to the same group in the periodic table? Also classify them in blocks.

24. The enthalpy change for the reaction, $Zn_{(s)} + 2H^+_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + H_{2(g)}$, is -154.40 kJ mol^{-1}. The formation of 2 g of hydrogen expands the system by 22.4 litres at 1 atm pressure. What is the internal energy change of the reaction?

25. At 540 K, 0.10 mol of PCl_5 are heated in a 8.0 L flask. The pressure of the equilibrium mixture is found to be 1.0 atm. Calculate K_p and K_c for the reaction.

26. What causes temporary and permanent hardness of water? *(NCERT, KVS 2014, 2019)*

27. Write the structure of the alkene which on reductive ozonolysis gives butanone and ethanal.

    OR

    A hydrocarbon *A*, adds one mole of hydrogen in presence of platinum catalyst to form *n*-hexane. When *A* is oxidised vigorously with $KMnO_4$, a single carboxylic acid containing three carbon atoms is isolated. Give the structure of *A* and explain.

SECTION - C

28. A solid mixture weighing 5.00 g containing lead nitrate and sodium nitrate was heated below 600°C until the mass of the residue was constant. If the loss of mass is 28%, find the mass of lead nitrate and sodium nitrate in the mixture. (At wts. of Pb = 207, Na = 23, N = 14, O = 16)

29. Describe the hybridisation scheme in case of PCl_5. Why are the axial bonds longer as compared to equitorial bonds? *(NCERT, NCT 2008, 2014)*

OR

(a) Use molecular orbital theory to explain why Be_2 molecule does not exist.

(b) (i) Which one has higher bond order N_2 or N_2^+?

(ii) Compare the stability of O_2^+ and O_2 on the basis of molecular orbital theory.

30. A 2.0 L container at 25 °C contains 1.25 mol of oxygen and 3.3 mol of carbon.

(a) What is the initial pressure in the flask?

(b) If carbon and oxygen react as completely as possible to form CO, what will be the final pressure in the container?

31. (a) Assign oxidation number to the underlined elements in each of the following species : (i) $K\underline{Mn}O_4$ (ii) $Ca\underline{O}_2$

(b) Identify the oxidising agent and reducing agent in the following reaction.

$$2MnO_4^- + 6I^- + 4H_2O \longrightarrow 2MnO_2 + 3I_2 + 8OH^-$$

(c) What do you understand by disproportionation reaction?

32. Give reasons for the following :

(i) $Be(OH)_2$ dissolves in NaOH but $Mg(OH)_2$ does not.

(ii) Magnesium oxide is used as a refractory material.

(iii) During electrolysis of molten sodium chloride, calcium chloride and potassium fluoride are added.

33. Complete the following reactions :

(i) $HC \equiv CH \xrightarrow{NaNH_2, CH_3Br} A$

(ii) $HC \equiv CH \xrightarrow{H_2O, HgSO_4/H_2SO_4} B$

(iii) $CH_3C \equiv CH + H_2 \xrightarrow{Pt/\ Pd/Ni} C \xrightarrow{H_2} D$

OR

7-Bromo-1, 3, 5-cycloheptatriene exists as an ion whereas 5-bromo-1, 3-cyclopentadiene does not form an ion even in presence of Ag^+. Explain.

34. How can you apply green chemistry for the following:

(i) To avoid use of halogenated solvents in dry cleaning and that of chlorine in bleaching.

(ii) To reduce use of synthetic detergents.

(iii) To reduce the consumption of petrol and diesel.

SECTION - D

35. (a) Write the name of the isomerism shown by the following pairs :

(i) Buta-1,3-diene and but-1-yne (C_4H_6)

(ii) Ethoxybutane and propoxypropane ($C_6H_{14}O$)

(b) Why 3° carbocations are more stable than 1° carbocations?

(c) Compare inductive and electromeric effects.

(d) Why CCl_3COOH is a stronger acid than $(CH_3)_3CCOOH$?

OR

(a) Why is an organic compound fused with sodium in Lassaigne's test?

(b) What is the Prussian blue coloured compound formed in the Lassaigne's test for confirming the presence of nitrogen in the organic compound?

(c) In a Dumas nitrogen estimation method, 0.30 g of an organic compound gave 50 cm^3 of N_2 collected at 300 K and 715 mm Hg pressure. Calculate the percentage composition of nitrogen in the compound. (Vapour pressure of water at 300 K is 15 mm Hg)

36. (i) Explain why the enthalpy changes for the given reactions are not enthalpies of formation of $CaCO_3$ and HBr.

(a) $CaO_{(s)} + CO_{2(g)} \rightarrow CaCO_{3(s)}$; $\Delta_r H^\circ = -178.3\ kJ\ mol^{-1}$

(b) $H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$; $\Delta_r H^\circ = -72.8\ kJ\ mol^{-1}$

(ii) Calculate the standard enthalpy change ($\Delta_r H^\circ$) and standard internal energy change ($\Delta_r U^\circ$) for the following reaction at 300 K :

$OF_{2(g)} + H_2O_{(g)} \rightarrow O_{2(g)} + 2HF_{(g)}$; Standard enthalpy of formation ($\Delta_f H^\circ$) of various species are given as :

$\Delta_f H^\circ/kJ\ mol^{-1}$: $OF_{2(g)} = 23.0$, $H_2O_{(g)} = -241.8$, $HF_{(g)} = -268.6$, $R = 8.314\ J\ K^{-1}\ mol^{-1}$

OR

Write expression for the work done by 1 mole of the gas in each of the following cases :

(i) For irreversible expansion of the gas from volume V_1 to V_2.

(ii) For reversible isothermal expansion of the gas from volume V_1 to V_2.

(iii) For expansion of the gas into an evacuated vessel.

(iv) For reversible isothermal compression of the gas from pressure P_1 to P_2.

(v) For adiabatic expansion resulting into change of temperature from T_1 to T_2.

37. (a) What is the molecular formula of inorganic benzene? Why is it called so? Name the two chemicals which when heated together forms inorganic benzene.

(b) What happens (write chemical equations.)

(i) when borax is heated strongly

(ii) BF_3 reacts with ammonia?

OR

(a) A tetravalent element forms monoxide and dioxide with oxygen. When air is passed over heated element (1273 K), producer gas is obtained. Monoxide of the element is a powerful reducing agent and reduces ferric oxide to iron. Identify the element and write formulas of its monoxide and dioxide. Write chemical equations for the formation of producer gas and reduction of ferric oxide with the monoxide.

(b) (i) Silica is a high melting solid. Explain.

(ii) Draw the structure of a cyclic silicate, $(Si_3O_9)^{6-}$.

SOLUTIONS

1. It is a titration of weak base with strong acid.
Hence, methyl orange is used as an indicator.

2. Strong acids can be used to titrate both strong and weak bases.

3. $h = \sqrt{\frac{K_w}{K_a \cdot c}} = \sqrt{\frac{10^{-14}}{6.4 \times 10^{-10} \times 1/160}}$

$= \sqrt{\frac{10^{-14} \times 160}{6.4 \times 10^{-10}}} = \sqrt{25 \times 10^{-4}} = 5 \times 10^{-2} = 0.05 = 5\%$

4. For salt of weak acid and weak base,

$pH = 7 + \frac{1}{2}[pK_a - pK_b] = 7 + \frac{1}{2}(4.76 - 4.75) = 7.005$

5. In 0.01 M HCl, $[Cl^-] \approx 0.01\ M = 10^{-2}\ M$
$[Ag^+]\ (10^{-2}) = 1.8 \times 10^{-10}$
or $[Ag^+] = 1.8 \times 10^{-8}$ M or 1.8×10^{-8} mol/dm^3

6. Azimuthal quantum number

7. Seaborgium (Sg)

8. van der Waals' forces

9. 4-Phenylbut-1-ene

10. Kieselguhr

11. (a) **12.** (a)

13. (a) **14.** (c)

15. **(a) :** Among alkali metal ions, Li^+ is the smallest. Therefore it has highest charge density and hence attracts water molecules more strongly than any other alkali metal cations.

16. **(b) :** ΔS is related with q and T for a reversible reaction as : $\Delta S = \frac{q_{rev}}{T}$

17. **(a) :** $\because E_2 - E_1 > E_3 - E_2 > E_4 - E_3$ and so on.

18. **(b)**

19. **(d) :** For greenhouse effect, presence of CO_2 and water vapour are essential.

20. **(c):** D_2O has higher molecular mass and greater degree of association than H_2O and thus, has higher melting and boiling points.

21. *Refer to answer 174 Page no. 36* (MTG CBSE Champion Chemistry Class 11)

22. *Refer to answer 64 Page no. 64* (MTG CBSE Champion Chemistry Class 11)

23. The first inert gas which contains *d*-electrons is krypton. Its atomic number is 36 and its electronic configuration is :
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6$.
Total number of *d*-electrons = 10
Total number of *p*-electrons = 6 + 6 + 6 = 18
Total number of *s*-electrons = 2 + 2 + 2 + 2 = 8
$\therefore$ Difference in total number of *p*- and *s*-electrons = 18 – 8 = 10.
Thus, the inert gas is krypton.

OR

A and *B* belong to same group of periodic table because they have same number of valence electrons and belongs to *p*-block. *A* to *D* also belongs to *p*-block and *E* belongs to *s*-block.

24. Taking the initial volume as negligible (as no gaseous reactant is present), change in volume during expansion $(\Delta V) = 22.4$ L. External pressure $(P_{ext}) = 1$ atm
$\Delta H = \Delta U + P\Delta V$ or $\Delta U = \Delta H - P\Delta V$
$P\Delta V = 1\ atm \times 22.4\ L = 22.4\ L\ atm = 22.4 \times 101.3\ J = 2269.12\ J$
$= 2.3\ kJ$
$\therefore \quad \Delta U = -154.4 - 2.3 = -156.7$ kJ

25.

	PCl_5	$\rightleftharpoons$	PCl_3	+	Cl_2
Initial	0.1 mol		0		0
At eqm.	$0.1 - x$		x		x

Total no. of moles at eqm. = $0.1 + x$

$$PV = nRT \text{ or } n = \frac{PV}{RT} = \frac{1 \times 8}{0.0821 \times 540} = 0.18$$

$$\therefore \quad 0.1 + x = 0.18 \Rightarrow x = 0.08 \therefore K_c = \frac{(0.08/8)(0.08/8)}{(0.02/8)} = 0.04$$

$$K_p = K_c(RT)^{\Delta n} = 0.04(0.0821 \times 540)^1 = 1.77$$

26. Temporary hardness of water is due to the presence of magnesium and calcium hydrogen carbonates. Permanent hardness of water is due to the presence of soluble salts of magnesium and calcium in the form of chlorides and sulphates in water.

27. $CH_3CH_2-\underset{\text{3-Methyl-2-pentene}}{\overset{CH_3}{\overset{|}{C}}=CHCH_3} \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3/CH_2Cl_2,196K}$

$CH_3CH_2-\underset{\text{Butanone}}{\overset{CH_3}{\overset{|}{C}}=O} + O=\underset{\text{Ethanal}}{CHCH_3}$

OR

(i) Since, the hydrocarbon *A* adds one mole of H_2 in presence of Pt to form *n*-hexane, therefore, *A* must be an hexene.
(ii) Since *A* on vigorous oxidation with $KMnO_4$ gives a single carboxylic acid containing three carbon atoms, therefore, *A* must be a symmetrical hexene, *i.e.*, hex-3-ene.

$$\underset{\text{Hex-3-ene}(A)}{CH_3CH_2CH=CHCH_2CH_3} \xrightarrow[KMnO_4]{[O]} \underset{\text{Propionic acid}}{2CH_3CH_2COOH}$$

Thus, the given hydrocarbon *A* is hex-3-ene.

28. $\underset{2\times331=662\text{ g}}{2Pb(NO_3)_2} \xrightarrow{\Delta} \underset{2\times223=446\text{ g}}{2PbO} + 4NO_2\uparrow + O_2\uparrow$

$$\underset{2\times85=170\text{ g}}{2NaNO_3} \xrightarrow{\Delta} \underset{2\times69=138\text{ g}}{2NaNO_2} + O_2\uparrow$$

Suppose $Pb(NO_3)_2$ in the mixture = x g

Then $NaNO_3$ in the mixture = $(5 - x)$ g

662 g of $Pb(NO_3)_2$ give residue = 446 g

$\therefore$ x g of $Pb(NO_3)_2$ will give residue = $\frac{446}{662} \times x$ g = $0.674\,x$ g

170 g of $NaNO_3$ give residue = 138 g

$\therefore$ $(5 - x)$ g of $NaNO_3$ will give residue = $\frac{138}{170} \times (5 - x)$ g

$= 0.812\,(5 - x)$ g

Actual residue obtained = Mass taken – Mass lost

$= 5 - \frac{28}{100} \times 5$ g = 3.6 g

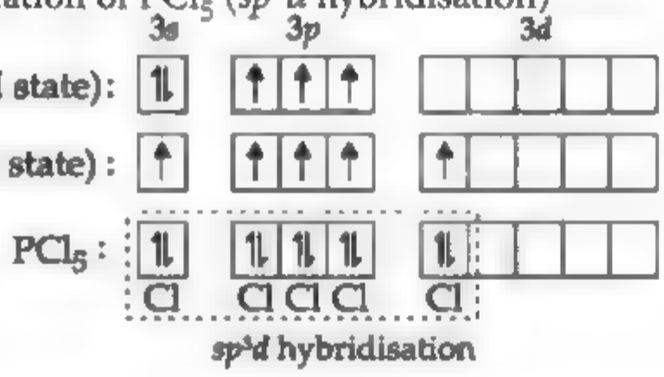
Thus, total residue = $0.674x + 0.812\,(5 - x) = 3.6$

or $0.138x = 0.46$ or $x = 3.33$ g

i.e., $Pb(NO_3)_2$ in the mixture = 3.33 g

$NaNO_3$ in the mixture = 5 – 3.33 = 1.67 g

29. Formation of PCl_5 (sp^3d hybridisation)



In PCl_5, there are three equatorial bonds and two axial bonds. The two axial bonds are at 90° to each other because the axial Cl atoms suffer more repulsion than the equatorial Cl atoms. As a result the axial Cl atoms tries to reside far away from the equatorial Cl atoms and hence axial bonds are longer than equatorial bonds.

OR

(a) Beryllium atom has electronic configuration $1s^2\,2s^2$. So, in Be_2 there are total eight electrons which must be filled in four molecular orbitals.

M.O. electronic configuration of

$Be_2 : \sigma 1s^2\,\sigma^* 1s^2\,\sigma 2s^2\,\sigma^* 2s^2$

B.O. = 1/2(4 – 4) = 0. Since the bond order is zero it shows that molecular beryllium will not exist.

(b) *Refer to answer 182 Page no. 133* (MTG CBSE Champion Chemistry Class 11)

30. **(a)** V = 2.0 L, T = 298 K, n = 1.25 mol (because only gas will exert pressure). Hence,

$PV = nRT$

or $P = \frac{nRT}{V} = \frac{(1.25\text{ mol})(0.0821\text{ L atm K}^{-1}\text{ mol}^{-1})(298\text{ K})}{2.0\text{ L}}$

= 15.3 atm

(b) The reaction will be : $C_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)}$

As 1 mol of C reacts with $\frac{1}{2}$ mol of O_2, the limiting reactant will be 1.25 mol of O_2. Thus, $\frac{1}{2}$ mol of O_2 produces CO = 1 mol.

$\therefore$ 1.25 mol of O_2 will produce CO = 2.50 mol.

Now, n(gaseous) = 2.50 mol. Hence,

$P = \frac{nRT}{V} = \frac{(2.50\text{ mol})(0.0821\text{ L atm K}^{-1}\text{ mol}^{-1})(298\text{ K})}{2.0\text{ L}}$

= 30.6 atm

31. **(a)** (i) Oxidation number of Mn in $KMnO_4$:

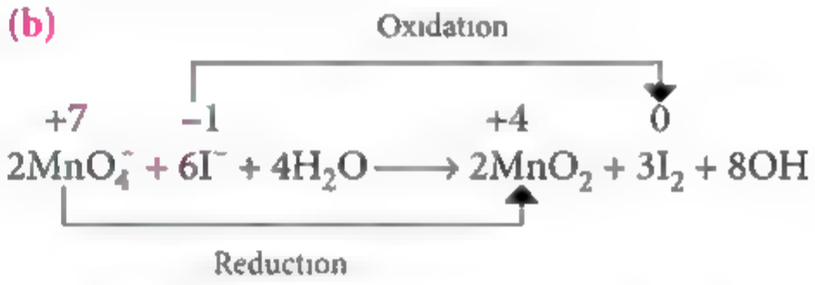
$1 + x + (-2) \times 4 = 0 \Rightarrow x = +7$

(ii) CaO_2

Let oxidation number of O be x,

$+2 + 2(x) = 0 \Rightarrow 2x = -2 \;\therefore\; x = -1$

(b)



Here, MnO_4^- is an oxidising agent as it itself gets reduced and I^- is a reducing agent as it itself gets oxidised.

(c) A reaction in which a particular species simultaneously gets oxidised and reduced, is known as disproportionation reaction.

+1 0 +2

e.g., $Hg_2Cl_2 \longrightarrow Hg + HgCl_2$

In this reaction, Hg_2Cl_2 is getting oxidised to $HgCl_2$ and also getting reduced to Hg.

32. **(i)** $Be(OH)_2$ is amphoteric and hence it dissolves in NaOH forming sodium beryllate.

$Be(OH)_2 + 2OH^- \longrightarrow \underset{\text{Beryllate ion}}{[Be(OH)_4]^{2-}}$

$Mg(OH)_2$ on the other hand, being basic does not dissolved in NaOH.

(ii) MgO has high lattice energy due to greater charge and smaller ionic size of Mg^{2+} and O^{2-} ions. As a result, it has a very high melting point and hence is used as a refractory material.

(iii) Pure sodium chloride melts at 1084 K. The cost of electricity to attain and maintain this temperature is very high. Furthermore, Cl_2 gas evolved during electrolysis has corrosive action on the cell at high temperatures. Therefore, to lower the fusion temperature to 850-875 K, some $CaCl_2$ and KF are added to molten NaCl.

33. **(i)** $HC\equiv CH \xrightarrow{NaNH_2} HC\equiv CNa \xrightarrow{CH_3Br} \underset{\substack{\text{Propyne}\\(A)}}{HC\equiv CCH_3}$

(ii) $CH\equiv CH \xrightarrow[HgSO_4]{\text{dil. } H_2SO_4}$

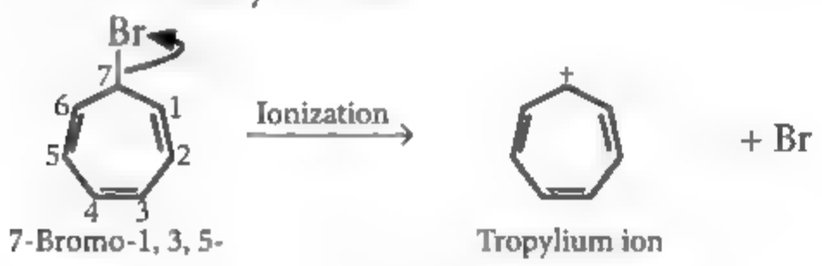
$$\underset{\text{(Unstable)}}{CH_2=CHOH} \xrightleftharpoons{\text{Tautomerisation}} \underset{\text{Ethanal}}{CH_3-\overset{\overset{O}{\|}}{C}-H}$$

(iii) $CH_3-\underset{\text{Propyne}}{C\equiv CH} + H_2 \xrightarrow{Pt/Pd/Ni}$

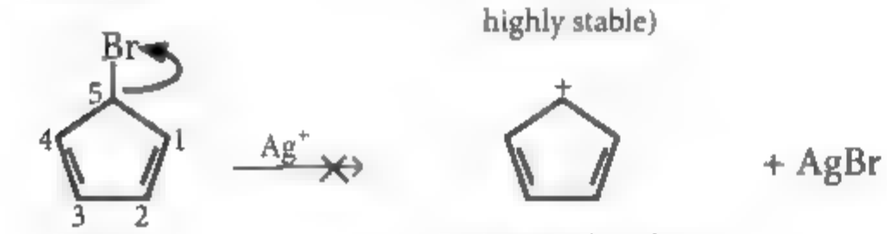
$$CH_3-\underset{\text{Propene}}{CH=CH_2} \xrightarrow{H_2} \underset{\text{Propane}}{CH_3-CH_2-CH_3}$$
(C) (D)

OR

7-Bromo-1, 3, 5-cycloheptatriene, on ionization, gives tropylium ion. Since, tropylium ion contains 6π-electrons which are completely delocalized, therefore, according to Huckel rule, it is aromatic and hence stable. Being highly stable it is easily formed.



7-Bromo-1, 3, 5-cycloheptatriene — Tropylium ion (6π-electrons, aromatic, highly stable)



5-Bromo-1, 3-cyclopentadiene — 1,3-Cyclopentadienyl cation (4π-electrons, anti-aromatic, highly unstable)

In contrast, 5-bromo-1, 3-cyclopentadiene, on ionization, will give 1, 3-cyclopentadienyl cation which contains 4 π-electrons and hence is anti-aromatic. Being anti-aromatic, it is highly unstable and hence is not formed even in the presence of Ag^+ ion which otherwise facilitates ionization.

34. **(i)** In dry cleaning liquefied CO_2 along with a suitable detergent is used and for bleaching, hydrogen peroxide is used which gives better results and is not harmful.

(ii) Soaps should be used in place of detergents because soaps are 100% biodegradable and do not cause any pollution problem. Now a days, soft detergents are available which are biodegradable. They can be used in place of 'hard detergents' which are non-biodegradable.

(iii) (a) CNG may be used as it causes much less pollution.

(b) Electrical vehicles should be used which have zero pollution. We expect a large number of electrical cars and two wheelers on the road in near future.

35. *Refer to answer 173 Page no. 364* (MTG CBSE Champion Chemistry Class 11)

OR

(a) The organic compound is fused with sodium so as to convert N, S and halogen present in the organic compound to their respective ionic sodium salts.

(b) $6CN^- + Fe^{2+} \rightarrow [Fe(CN)_6]^{4-}$

$$3[Fe(CN)_6]^{4-} + 4Fe^{3+} \xrightarrow{xH_2O} \underset{\substack{\text{Prussian blue}\\ \text{Iron(III) hexacyanoferrate(II)}}}{Fe_4[Fe(CN)_6]_3\cdot xH_2O}$$

(c) *Refer to answer 232 Page no. 369* (MTG CBSE Champion Chemistry Class 11)

36. **(i)** (a) Given enthalpy change is not enthalpy of formation of $CaCO_3$ because it is not being formed from constituting elements.

(b) Given enthalpy change is not enthalpy of formation of HBr because 2 moles of HBr are being formed.

(ii) $OF_{2(g)} + H_2O_{(g)} \rightarrow O_{2(g)} + 2HF_{(g)}$

$\Delta n = 1 + 2 - 2 = 1$

$\Delta_r H^\circ = \sum \Delta_f H^\circ_{(products)} - \sum \Delta_f H^\circ_{(reactants)}$

$= \Delta_f H^\circ(O_2) + 2\Delta_f H^\circ(HF) - \Delta_f H^\circ(OF_2) - \Delta_f H^\circ(H_2O)$

$= 0 + 2 \times (-268.6) - 23.0 - (-241.8)$

$= -537.2 - 23.0 + 241.8 = -318.4$ kJ / mol

$\Delta_f H^\circ = \Delta_r U^\circ + \Delta n_g RT$

$-318.4 \text{ kJ} = \Delta_r U^\circ + \frac{1 \times 8.314 \times 300}{1000} \text{ kJ}$

$-318.4 \text{ kJ} = \Delta_r U^\circ + 2.4942 \text{ kJ}$

$\therefore \quad \Delta_r U^\circ = -320.9$ kJ

OR

(i) Irreversible expansion takes place when external pressure (P_{ext}) remains constant.

$w_{irrev} = -P_{ext}(V_2 - V_1) = -P_{ext}\Delta V$

(ii) Reversible expansion takes place when internal pressure is infinitesimally greater than external pressure at every stage. Thus, external pressure has to be adjusted throughout.

$w_{rev} = -nRT \ln V_2/V_1$

(iii) The expansion is irreversible. Further, as $P_{ext} = 0$, therefore,

$w = -P_{ext}\Delta V = 0 \times (\Delta V) = 0$

(iv) When gas is compressed, work is done on the gas. For isothermal reversible compression,

$w = +nRT \ln P_2/P_1$

(v) For adiabatic expansion, temperature falls, *i.e.*, $T_2 < T_1$

$w = C_v(T_2 - T_1)$, *i.e.*, w is –ve.

37. **(a)** Molecular formula of inorganic benzene is $B_3N_3H_6$. It is a volatile compound and is called inorganic benzene because of the similarity of its structure with benzene. It has a six membered ring of alternating B and N atoms, each is further linked to a H atom. It is prepared by reacting B_2H_6 and NH_3 at 180 °C.

$$3B_2H_6 + 6NH_3 \xrightarrow{180^\circ C} 2B_3N_3H_6 + 12H_2$$

(b) **(i)** When powdered borax is heated strongly on the Bunsen burner, it forms colourless transparent glassy (glass like) bead made of sodium metaborate and boric anhydride.

$$Na_2B_4O_7\cdot 10H_2O \xrightarrow{\Delta} Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

(ii) *Refer to answer 69(b) Page no. 323* (MTG CBSE Champion Chemistry Class 11)

OR

(a) The tetravalent element is carbon which forms CO and CO_2. When heated in air it forms producer gas.

$$\underbrace{2C + O_2 + 4N_2}_{\text{(From air)}} \xrightarrow{1273\text{ K}} \underbrace{2CO + 4N_2}_{\text{Producer gas}}$$

CO is a powerful reducing agent and reduces ferric oxide to iron.

$$Fe_2O_3 + 3CO \xrightarrow{\Delta} 2Fe + 3CO_2$$

(b) *Refer to answer 160 Page no. 328* (MTG CBSE Champion Chemistry Class 11)

MONTHLY TEST DRIVE

This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Total Marks : 120

States of Matter | Thermodynamics

Time Taken : 60 Min.

NEET

Only One Option Correct Type

1. For non-zero value of force of attraction between gas molecules, gas equation will be

(a) $PV = nRT - \frac{n^2}{V}a$ (b) $PV = nRT + nbP$

(c) $P = \frac{nRT}{V - b}$ (d) $PV = nRT$

2. The free energy change for the following reactions are given below :

$C_2H_{2(g)} + \frac{5}{2}O_{2(g)} \longrightarrow 2CO_{2(g)} + H_2O_{(l)}$;

$\Delta G^\circ = -1234$ kJ

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$; $\Delta G^\circ = -394$ kJ

$H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$; $\Delta G^\circ = -237$ kJ

What is the standard free energy change for the reaction?

$H_{2(g)} + 2C_{(s)} \longrightarrow C_2H_{2(g)}$

(a) –209 kJ (b) –2259 kJ

(c) 2259 kJ (d) 209 kJ

3. Containers *A* and *B* have same gases. Pressure, volume and temperature of *A* are all twice that of *B*, then the ratio of number of molecules of *A* and *B* are

(a) 1 : 2 (b) 2 : 1

(c) 1 : 4 (d) 4 : 1

4. In which of the following conditions a chemical reaction cannot occur?

(a) ΔH and ΔS increases and $T\Delta S > \Delta H$

(b) ΔH and ΔS decreases and $\Delta H > T\Delta S$

(c) ΔH increases and ΔS decreases

(d) ΔH decreases and ΔS increases

5. Surface tension of water is 73 dyne cm^{-1} at 20°C. If surface area is increased by 0.10 m^2, work done is

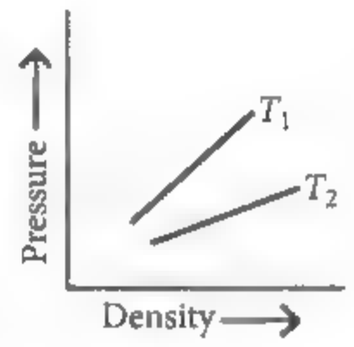
(a) 7.3 erg (b) 7.3×10^4 erg

(c) 73 J (d) 0.73 J

6. 4.48 L of an ideal gas at STP requires 12.0 calories to raise its temperature by 15°C at constant volume. The C_p of the gas is

(a) 3 cal (b) 4 cal (c) 7 cal (d) 6 cal

7. Figure shows graphs of pressure *vs.* density for an ideal gas at two temperatures T_1 and T_2. Which of the following options is correct?



(a) $T_1 > T_2$

(b) $T_1 = T_2$

(c) $T_1 < T_2$ (d) None of these

8. Heat of dissociation of benzene to elements is 5535 kJ mol^{-1}. The bond enthalpies of C—C, C=C and C—H are 347.3, 615.0 and 416.2 kJ respectively. Resonance energy of benzene is

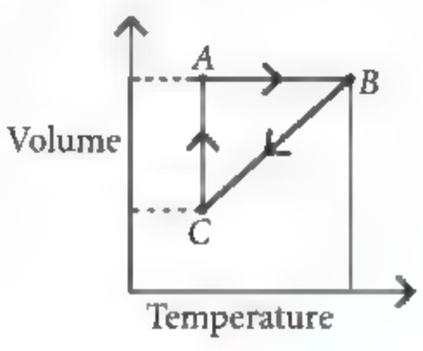
(a) 1.51 kJ (b) 15.1 kJ (c) 151 kJ (d) 1511 kJ.

9. If for two gases of molecular weights M_A and M_B at temperature T_A and T_B, $T_AM_B = T_BM_A$, then which property has the same magnitude for both the gases?

(a) Density (b) Pressure

(c) *KE* per mole (d) u_{rms}

10. Five moles of a gas is put through a series of changes as shown graphically in a cyclic process. The processes $A \rightarrow B$, $B \rightarrow C$ and $C \rightarrow A$ are respectively



(a) isochoric, isobaric and isothermal
(b) isobaric, isochoric and isothermal
(c) isochoric, isothermal and isobaric
(d) isobaric, isothermal and isochoric.

11. Pure hydrogen sulphide is stored in a tank of 100 litre capacity at 20°C and 2 atm pressure. The mass of the gas will be
(a) 34 g (b) 340 g
(c) 282.68 g (d) 28.24 g

12. Consider the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ carried out at constant temperature and pressure. If ΔH and ΔU are the enthalpy and internal energy changes for the reaction, which of the following expressions is true?
(a) $\Delta H = 0$ (b) $\Delta H = \Delta U$
(c) $\Delta H < \Delta U$ (d) $\Delta H > \Delta U$

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** Most probable velocity is the velocity possessed by maximum fraction of molecules at the same temperature.
Reason : On collision, more and more molecules acquire higher speed at the same temperature.

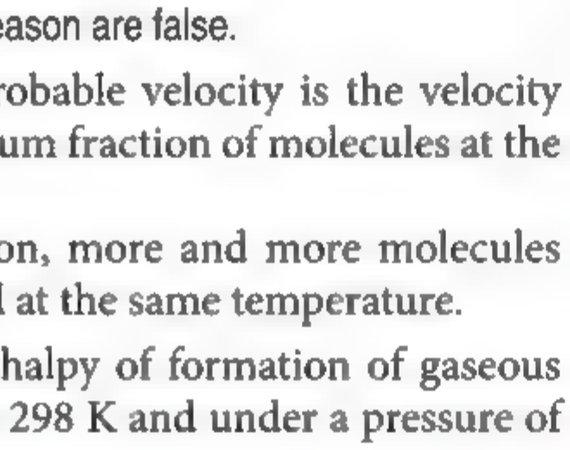
14. **Assertion :** The enthalpy of formation of gaseous oxygen molecules at 298 K and under a pressure of 1 atm is zero.
Reason : The entropy of formation of gaseous oxygen molecules under the same conditions is zero.

15. **Assertion :** The heat of neutralisation of perchloric acid, $HClO_4$, with NaOH is same as that of HCl with NaOH.
Reason : Both HCl and $HClO_4$ are strong acids.

JEE MAIN / ADVANCED

Only One Option Correct Type

16. The given system is in equilibrium at 27°C and the volume of the bulb is 150 mL. At 27°C, aqueous tension of water is 28 mm of Hg. If the bulb contains 0.001 mol of O_2, volume of liquid water present in the bulb is nearly
(a) 10 mL (b) 20 mL (c) 30 mL (d) 40 mL.



17. Diborane is a potential rocket fuel which undergoes combustion according to the reaction,
$B_2H_{6(g)} + 3O_{2(g)} \rightarrow B_2O_{3(s)} + 3H_2O_{(g)}$
From the following data, calculate the enthalpy change for the combustion of diborane.

$2B_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow B_2O_{3(s)}\ ; \Delta H = -1273\ kJ\ mol^{-1}$

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}\ ; \Delta H = -286\ kJ\ mol^{-1}$

$H_2O_{(l)} \rightarrow H_2O_{(g)}\ ;\ \Delta H = 44\ kJ\ mol^{-1}$

$2B_{(s)} + 3H_{2(g)} \rightarrow B_2H_{6\,(g)}\ ;\ \Delta H = 36\ kJ\ mol^{-1}$

(a) $\Delta H = 2035$ kJ (b) $\Delta H = -2035$ kJ
(c) $\Delta H = 1023$ kJ (d) $\Delta H = -7052$ kJ

18. 4.215 g of a metallic carbonate was heated in a hard glass tube and the CO_2 evolved was found to measure 1336 mL at 27°C and 700 mm pressure. What is the equivalent weight of the metal?
(a) 15.20 (b) 20.15 (c) 19.45 (d) 12.16

19. In conversion of limestone to lime, $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$ the values of $\Delta H°$ and $\Delta S°$ are +179.1 kJ mol^{-1} and 160.2 J/K respectively at 298 K and 1 bar. Assuming that $\Delta H°$ and $\Delta S°$ do not change with temperature, temperature above which conversion of limestone to lime will be spontaneous is
(a) 1118 K (b) 1008 K
(c) 1200 K (d) 845 K

More than One Options Correct Type

20. Which of the following are the equation of Boyle's law?
(a) $\left(\frac{dp}{dV}\right)_T = \frac{K}{V}$ (b) $\left(\frac{dp}{dV}\right)_T = -\frac{K}{V^2}$
(c) $\left(\frac{dp}{dV}\right)_T = \frac{K^2}{V}$ (d) $V \propto \frac{1}{p}$

21. In a closed insulated container a liquid is stirred with a paddle to increase the temperature which of the following are not true?
(a) $\Delta U = W \neq 0, q = 0$ (b) $\Delta U = W = q \neq 0$
(c) $\Delta U = 0, W = q \neq 0$ (d) $W = 0, \Delta U = q \neq 0$

22. Which of the following statements are correct?
(a) The ratio of the mean speed to the *rms* speed is independent of the temperature.
(b) The square of the mean speed of the molecules is equal to the square of the *rms* speed at a certain temperature.

(c) Mean kinetic energy of the gas molecules at any given temperature is independent of the mean speed.

(d) The difference between the *rms* speed and the mean speed at any temperature for different gases diminishes as larger and yet larger molar masses are considered.

23. The correct expressions for an adiabatic process are

(a) $\frac{T_2}{T_1}=\left(\frac{V_1}{V_2}\right)^{\gamma-1}$ (b) $\frac{P_2}{P_1}=\left(\frac{T_1}{T_2}\right)^{\gamma-1}$

(c) $P_1V_1^{\gamma}=P_2V_2^{\gamma}$ (d) $P_1V_1^{\gamma-1}=P_2V_2^{\gamma-1}$

Numerical Value Type

24. 3.7 g of a gas at 25°C occupied the same volume as 0.184 g of hydrogen at 17°C and at the same pressure. What is the molecular weight of the gas?

25. The enthalpy change involved in the oxidation of glucose is −2880 kJ mol^{-1}. Twenty five per cent of this energy is available for muscular work. If 100 kJ of muscular work is needed to walk one kilometer, what is the maximum distance in km that a person will be able to walk after eating 120 g of glucose?

26. Calculate the volume occupied in L by 5.0 g of acetylene gas at 50°C and 740 mm pressure.

Matrix Match Type

Answer the following questions (27 and 28) by appropriately matching the columns based on the information given in the passage :

The deviation from ideal gas behaviour can also be expressed by compressibility factor *Z*. Compressibility factor is the ratio of volume of real gas, V_{real} to the ideal volume of the gas, V_{ideal}.

$$Z=\frac{PV_{real}}{nRT}=\frac{V_{real}}{V_{ideal}},\ V_{ideal}=\frac{nRT}{P}$$

	Column-I		Column-II
P.	*Z* for ideal gas	I.	3/8
Q.	*Z* for real gas at low *P*	II.	$\left(1+\frac{Pb}{RT}\right)$
R.	*Z* for real gas at high *P*	III.	1
S.	*Z* for critical state	IV.	$\left(1-\frac{a}{RTV}\right)$

27. Which of the following has the correct combination considering column-I and column-II?

(a) P → II (b) Q → III

(c) R → IV (d) S → I

28. Which of the following has the correct combination considering column-I and column-II?

(a) P → III (b) Q → I

(c) R → IV (d) S → II

Answer the following questions (29 and 30) by appropriately matching the columns based on the information given in the passage :

Free energy, $G = H - TS$, is a state function that indicates whether a reaction is spontaneous or non-spontaneous.

Also, $\Delta G = \Delta H - T\Delta S$

If $\Delta G < 0$, the reaction is spontaneous.

If $\Delta G > 0$, the reaction is non-spontaneous.

If $\Delta G = 0$, the reaction is at equilibrium.

Column-I (Parameters)	Sign of ΔH	Sign of ΔS	Column-II (Description for spontaneity)	
P.	−	+	I.	Non-spontaneous at any *T*
Q.	+	−	II.	Spontaneous at any *T*
R.	−	−	III.	Non-spontaneous at low *T*
S.	+	+	IV.	Non-spontaneous at high *T*

29. Which of the following has the correct combination considering column-I and column-II?

(a) P → IV (b) Q → I

(c) R → III (d) S → II

30. Which of the following has the correct combination considering column-I and column-II?

(a) P → I (b) Q → III

(c) R → IV (d) S → II

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		If your score is	
No. of questions attempted	.....	> 80%	Your preparation is going good, keep it up to get high score.
No. of questions correct	.....	60-80%	Need more practice, try hard to score more next time.
Marks scored in percentage	.....	<60%	Stress more on concepts and revise thoroughly.

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